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THE ARBORETUM BULLETIN

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ARBORETUM BULLETIN

VOLUME 39, NUMBER 3, 1976

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COVER
Cornus kousa in fruit

Photo: Mrs. Conner Gray, Jr.

TREES — THE SILENT HISTORIANS

*LINDA B. BRUBAKER**

Trees, like human beings, remember the significant events in their lives — but by more long-lasting means than the human memory. A tree's experiences are recorded in the physical appearance of its growth rings. Such tree-ring records are studied by a branch of science called dendrochronology. By deciphering the memories of trees, dendrochronologists hope to learn much about natural environments that have never been witnessed by historians.

Tree-rings are the concentric layers of wood in the stems of trees. Differences in size and thickness of the cells make it easy to distinguish one ring from another. In conifers (Fig. 1), the wood cells formed early in the growing season (earlywood) are larger and thinner-walled than those formed late in the season (latewood). Since earlywood is light in color and latewood is dark, there is a sharp contrast between the latewood of one season and the earlywood of the next. These distinct boundaries make the rings easy to count with the naked eye. Counting backward from the most recent season's ring just below the bark to the ring at the stem's center will determine the age of the tree.

Tree-rings make very good records of time in temperate zone forests where only one layer of wood is produced each year. They also make good records of environmental changes, because many things can affect their characteristics: weather, fire, insects, tilting — all can change the width, color and cellular structure of annual rings and thereby leave an impression of their occurrence.

*Dr. Brubaker is Assistant Professor of Dendrochronology on the faculty of the College of Forest Resources, University of Washington. We are pleased to welcome her as a new member of the editorial board.

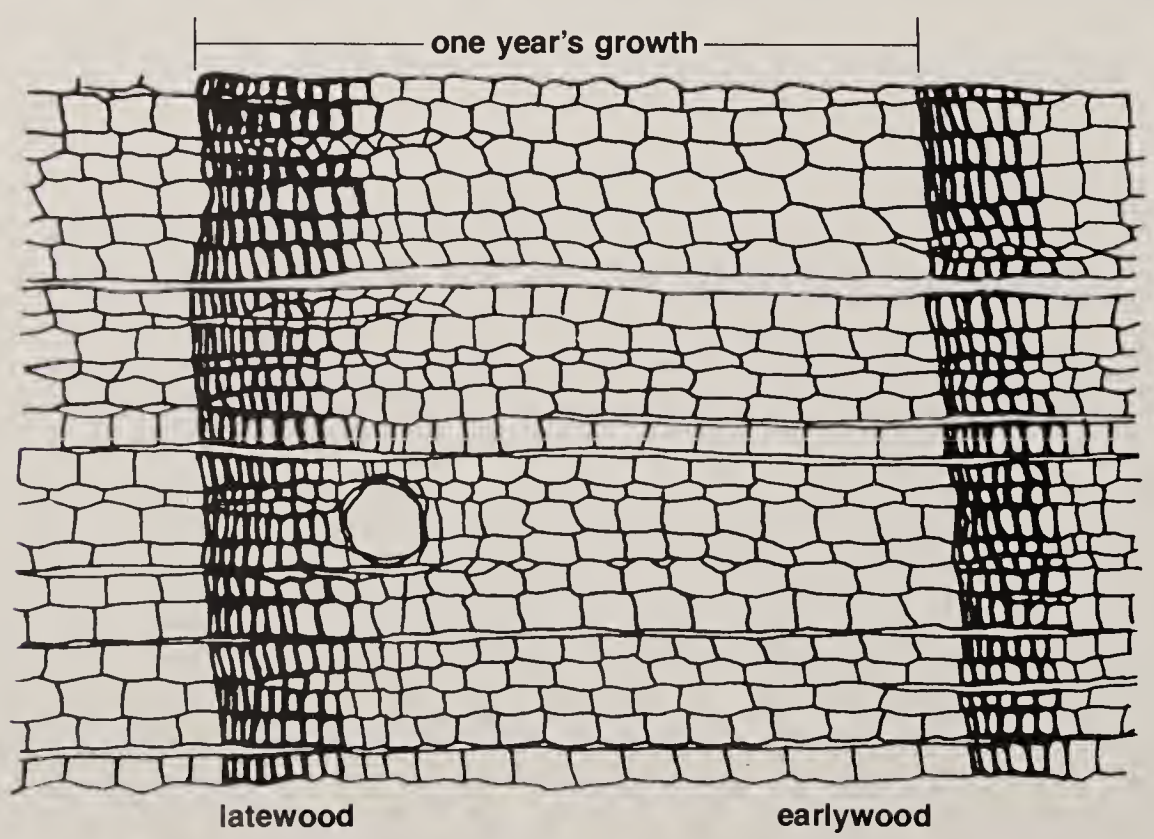

Fig. 1. An annual growth ring of a typical conifer is indicated by the succession of cells from light to dark. Note that the earlywood cell-type (larger and lighter) changes gradually (right to left) into latewood type (smaller and darker) within a single ring, but the transition between cells of adjacent rings is sharp.

Tree-ring widths are studied more often than any other ring feature. The wood samples are usually collected from trees or logs with hand or motorized increment borers. The cores are sanded and dated in the laboratory and the rings measured under the microscope. The measurements are often recorded automatically by electronic data logging systems which send them directly to computer files for storage and later analysis.

Cross-Dating

Dendrochronology began with the work of Andrew Ellicott Douglass, an astronomer in the southwestern United States. Near the beginning of this century, Douglass became interested in using tree-rings to study the activity of sunspots. He reasoned that if solar storms affect weather conditions on the earth, and if weather in turn affects the growth rates of trees, then variations in the widths of tree-rings might provide a way to study variations in sunspot activity over time.

Although Douglass never found his hypothetical link between sunspots and tree-rings, he did develop many techniques which are still being used by dendrochronologists. Probably his greatest contribution was the technique of cross-dating, which is how we date dead trees and objects made of wood. This method is possible because trees experiencing the same weather conditions will produce similar sequences of wide and narrow rings; therefore, if ring patterns in two pieces of wood match, we know that the trees from which they came were alive during the same period of time. An old piece of wood can be dated exactly if its ring pattern can be matched in a living tree of known age, or sometimes to bridge this time gap we use a specimen of wood from a tree whose lifespan overlapped both the old and the now-living wood (Fig. 2).

Cross-dating has become a valuable archaeological tool; for example, it has been used to date pieces of wood and charcoal from most prehistoric Indian villages in the Southwest. At Mesa Verde National Monument in Colorado, a close look at the beams of the ancient cliff dwellings will reveal the small holes where cores of wood were removed by the modern excavators. In Europe, dendrochronologists are using the same cross-dating techniques to study medieval and Renaissance buildings; even the exact dates of paintings on wood by the Dutch masters of the 16th, 17th and 18th centuries have been found in this way.

Weather

Since variations in the weather cause vari-

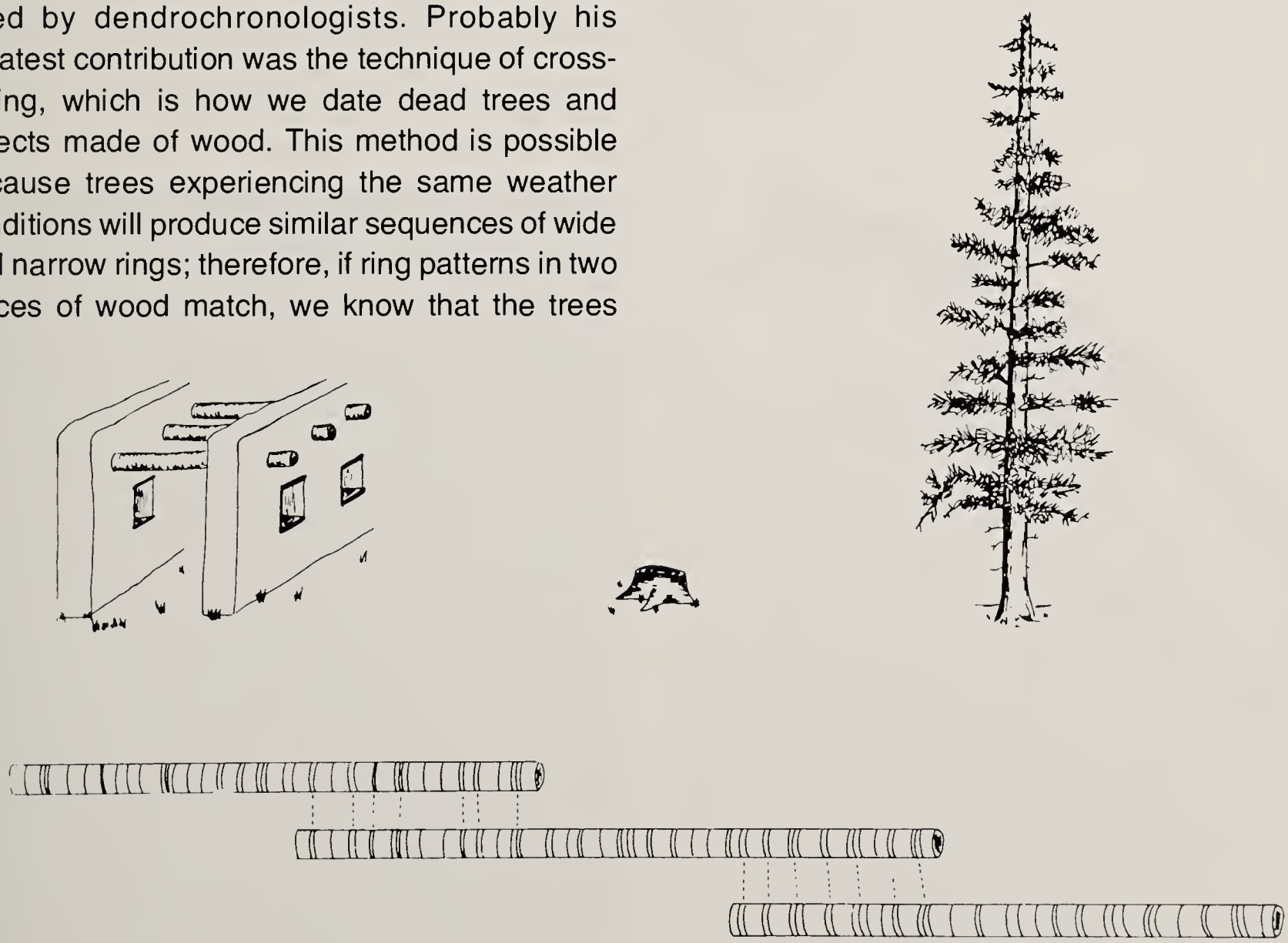

Fig. 2. A hypothetical example showing how ring patterns can be traced between pieces of wood which overlap in time. In this case, the ring sequence of a stump bridges a gap between the patterns in a living tree and those in an ancient beam. Counting from the outer ring of the tree back through the ring pattern present in the stump to the outer ring of the beam establishes the date when the tree was cut for the construction of the building.

ations in tree-ring widths, the ring characteristics of old wood provide records of what climatic changes took place before modern weather stations began keeping track. Climatologists are seeking knowlege of changes in past climates in order to find clues to the kinds of weather events that we can expect in the future. Researchers hope that this kind of data will help them understand why the earth's weather behaves as it does. For instance, tree-ring data can tell us how often severe regional droughts, such as the one responsible for the dust bowl conditions of the 1930's, occurred in the climatic history of the United States. If they were common features, we might well look for another one in the near future. Fortunately, tree-ring studies indicate that long, widespread droughts are relatively rare in North America; another one will probably not happen again in our lifetime.

Such use of tree-rings to interpret past climates is called dendroclimatology, and it is by far the most active part of dendrochronology today. Dendroclimatic research has expanded from its origin in the activities of Douglass in the Southwest to include analyses of climatic information from the Pacific Northwest, Alaska, Canada, Mexico, South America, Europe and Russia.

Fires

In the past few years, scientists have begun to use tree-rings to study non-climatic influences in the forest environment. In some places forest fire histories are being written from records in trees. A fire scars a tree by killing the living tissue underneath the bark. This causes the bark to slough off in that spot and expose a smooth surface of wood. The time of the forest fire can then be determined by counting from the ring now growing beneath the undamaged bark back to the ring which forms the surface of the scar (Fig. 3). Often trees contain long-term records of fires because living tissue will grow over old scarred areas and then itself become scarred in subsequent fires. Sometimes, new bark will completely cover these scars so that the fire record is totally hidden within the tree (Fig. 4). One graduate student at the University of Washington has counted more than 15 fire scars buried in the stem of an old ponderosa pine which grew in Mount Lassen National Park in northern California.

Fire scars can be seen on trees in most coniferous forests throughout the drier parts of the United States; few stands of trees east of the Cascade Mountain crest and continuing through

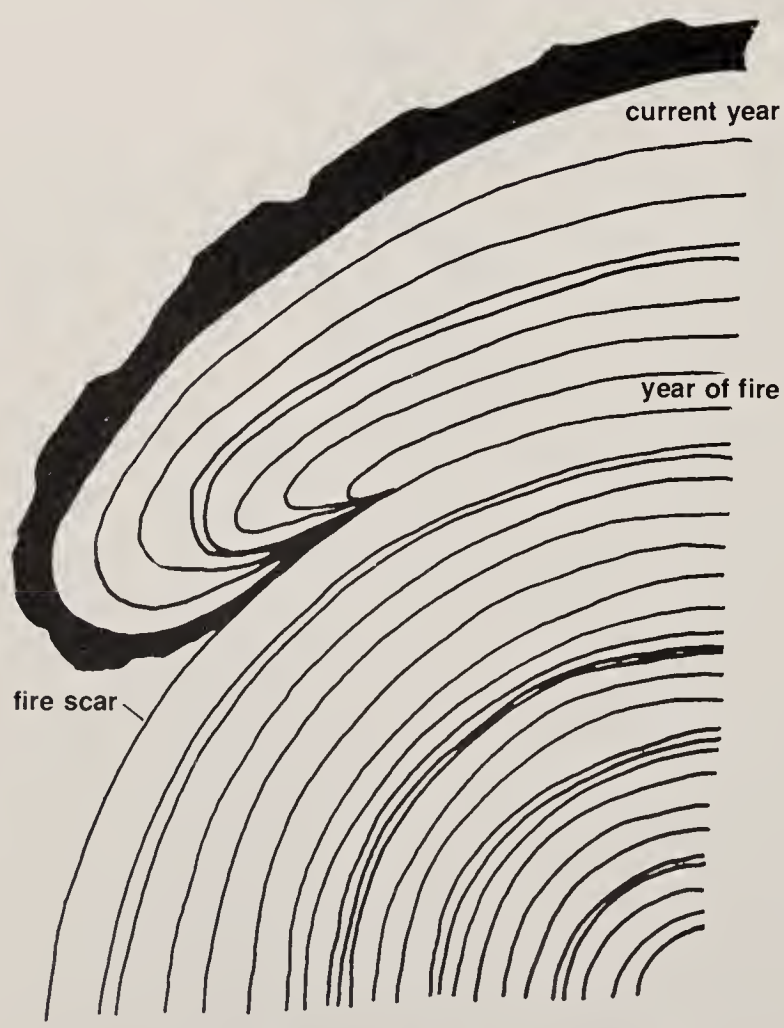

Fig. 3. An exposed fire scar and adjacent normal growth rings. The number of rings between the outer bark and the scar tells how long ago the fire occurred.

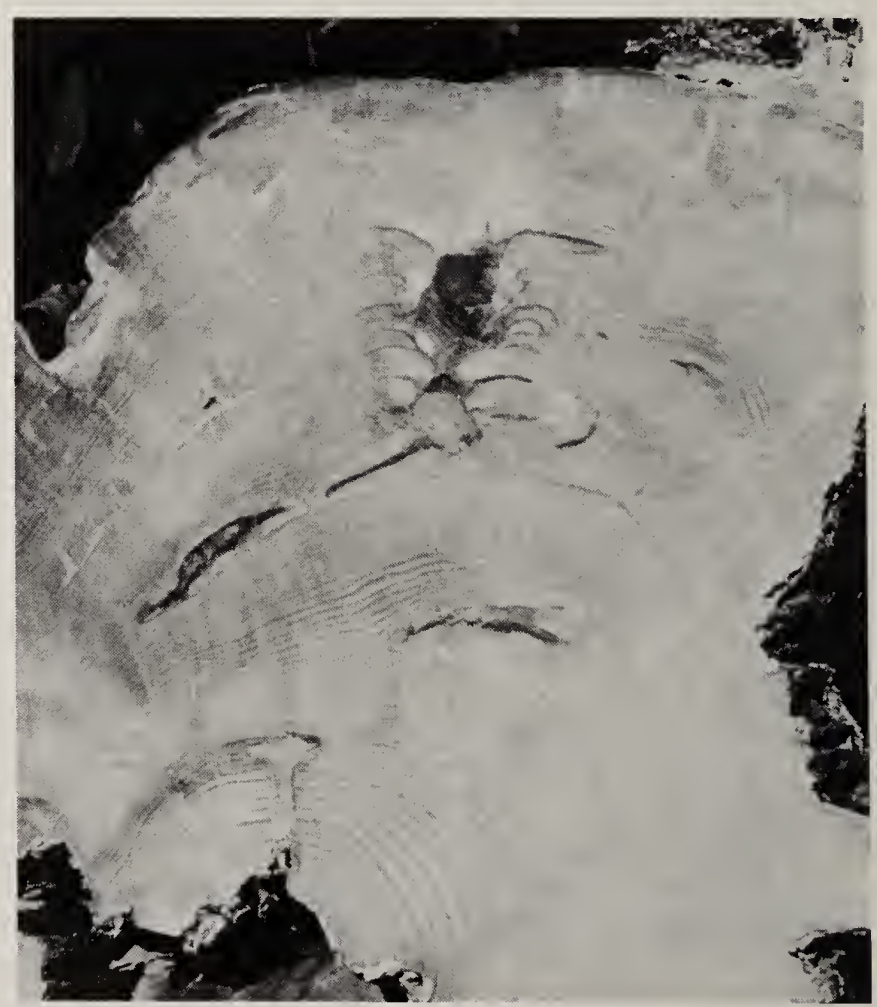

Fig. 4. Buried fire scars in the stem of a large ponderosa pine tree *(Pinus ponderosa)*. Even though the surface has not been polished, one can easily see a series of about 10 fire scars near the center of the photograph and several others in surrounding areas.

the Rockies are free from fire scars. The widespread occurrence of such scars indicates that fire is an important natural agent in many forest systems. Indeed, fires have been such a common part of the forest environment that many species have developed special adaptations for surviving forest fires. The thick bark of Douglas fir *(Pseudotsuga menziesii),* for example, furnishes good insulation for the fragile underlying tissue. Some geographic races of lodgepole pine *(Pinus contorta)* produce cones that will open and release their seeds only after the heat of a fire has loosened the cone scales. This allows parent lodgepole pines to distribute their seeds immediately onto newly opened ground and give their offspring an important headstart over competing tree species. In addition, recent research from northern Minnesota indicates that, in undisturbed forests, a certain natural frequency of spontaneous fires helps determine the distribution of plant communities.

With the realization that forest fires are important natural managers, some forest ecologists are proposing that fires should be allowed to burn in wilderness areas and national forests where there is no danger to human life or property. Before such policies can be initiated on a wide scale, we must first know how often forest fires occur naturally in each kind of vegetation. This information is nearly impossible to obtain other than by dendrochronology, because forest fires have been systematically excluded from most U.S. forests since about 1911, and we have few written reports of naturally occurring fires from before that time. Trees which were alive before man began to change the natural frequency of forest fires may, therefore, be the only sources for the information that is needed to intelligently reinstate fires into modern forests.

Insects

In addition to weather and fires, insect attacks leave their distinctive marks in tree-ring sequences. Some insects, such as bark beetles, scar the outer rings of trees by forming long, narrow channels in the wood just beneath the bark. Other insects — defoliating species like the spruce budworm, the Douglas fir tussock moth, and the lodgepole pine leaf miner — alter tree-rings in an indirect way. By consuming the tree's foliage, they reduce the amount of photosynthesis that the tree can carry out and thereby limit

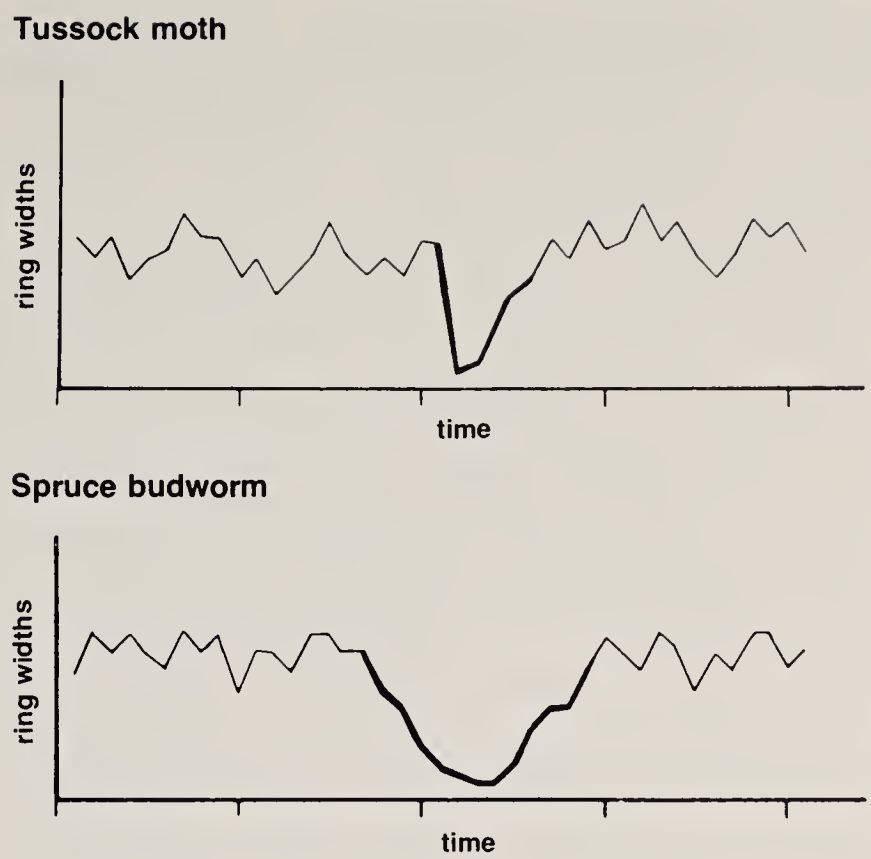

Fig. 5. Hypothetical ring-width sequence showing the effects of Douglas fir tussock moth and western spruce budworm attacks. The thickened lines indicate the typical ring-damage pattern caused by each insect species.

the amount of food available for the tree to produce wood cells in new rings. The reduction in ring widths resulting from defoliation is often greater than that caused by severe droughts. Trees are amazingly resilient to defoliation, however, and they usually return to normal growth rates within a few years after the insect attack. As a result, many living trees contain records of long-past insect outbreaks.

In some cases, the rings even reveal which insect defoliator caused the damage. Two of the most important pests attacking Douglas fir and true firs *(Abies)* are the Douglas fir tussock moth and the western spruce budworm. These insects affect tree-ring patterns in recognizably different ways (Fig. 5). The Douglas fir tussock moth reduces tree-ring widths abruptly — often to only 10% of normal growth within a year. The insect populations build up so rapidly that they can remove several years' production of needles in a single season and sometimes completely defoliate large trees in a few months. The insects disappear as quickly as they arise, but it takes the tree four to five years to recover and grow back a full set of needles. During this same time, ring widths will return to normal too.

By contrast, a spruce budworm attack usually causes ring widths to decrease gradually over a period of four to five years. Loss of ring growth is less noticeable because the spruce budworms build up in number more slowly than do tussock

moths. But an equally long time is then needed after the budworms leave for ring growth to return to normal, so that the total impact on the tree might be eight to ten years.

Since their growth is so sensitive to the population dynamics of tussock moth and spruce budworm, Douglas fir and true firs may provide important, long-term historical evidence of infestation by these insect pests. Other kinds of trees probably contain records of other insect species. Such records would be very valuable to an understanding of how logging activities are affecting insect populations. Some foresters feel that insect outbreaks have become more common since the turn of the century, because dense, young forests have replaced the original, less densely timbered stands. According to their theories, insect populations can grow and spread more rapidly in the extensive stands of young trees existing today. We should be prepared to deal with severe future insect problems if this is so, but we need long-range knowledge of past insect outbreaks to be sure our concern is justified.

Analysis

Since so many things can influence the widths of rings, one might ask how we can be sure that we know which factor is responsible for a particular tree-ring pattern. How do we know, for instance, that insects and not climate caused a set of narrow rings? To answer this kind of question, dendrochronologists must be both detectives and careful observers of how present day environments affect tree growth.

We can usually distinguish between the effects of insects and climate by examining all of the tree species in a stand. Most insects attack a limited number of tree species and leave all others undamaged. As a result, insect-attack ring patterns will be present in some, but not all of the tree species in an area. By contrast, the impact of climate may vary in magnitude from species to species, but its effect is usually present in the ring records of them all.

To determine the actual nature of past climates from tree-ring records, dendrochronologists must understand how climate influences tree growth. We compare ring widths to instrumental weather records during recent periods when both are available and identify which weather conditions are associated with wide and narrow rings. We then use this information to reconstruct the past conditions which caused ancient variations in ring widths.

With the realization that tree-rings tell more than a tree's age, environmental scientists have become eager to unravel other messages that they contain. Trees growing on avalanche tracks, for instance, reveal the frequency of avalanches in remote mountain areas and trees near glaciers show the history of ice movements. Trees can hold records of floods, earthquakes, volcanic eruptions, and even cosmic radiation. Dendrochronologists feel that tree-ring analyses will continue to play an important role in environmental research.

Acknowledgement

I thank Gretchen Furber for numerous editorial improvements to the original manuscript.

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ARBORETUM ANNUAL REPORT

June 1, 1976 — May 30, 1976

JOSEPH A. WITT
Curator of Plant Collections

The joint maintenance agreement between the University and the Seattle Park and Recreation Department went into operation 18 months ago. Aside from a few problems concerning who does what, the two staffs have a good history of cooperation and the appearance of the Arboretum grounds is gradually improving. The city staff is responsible for projects concerned primarily with the grounds, maintenance of the turf, picking up trash, care of the service roads and trails, etc. The university crew has responsibility for planning and development of new plantings, introduction and growing of new plant materials and care of existing collections. The Japanese Garden is entirely under university control as is the nursery and greenhouse complex.

While the lower-level operations are relatively frictionless, there are some areas of disagreement at higher levels. For example, the bridge to Foster's Island is no longer safe for heavy vehicles because its wooden supports have rotted. The two institutions have been negotiating for nearly a year over who is responsible for its replacement. A decision finally was made regarding its reconstruction, but so far no action has been taken, and we are still denied truck access to this important section of the Arboretum. Other areas where problems have arisen concern the replacement of the chain gates on Arboretum Drive East and increased traffic through the Arboretum because of the closure of East Prospect Street. The long delayed Memorial Gates have been fabricated by the artist, Professor George Tsutakawa, but their location in the Arboretum has been the center of controversy. It is hoped that these handsome gates will finally be placed on Arboretum Drive East, just south of the entrance to the office parking lot some time in the fall of 1976.

Staff

Two changes were made in the university and one in the city staff. Ms. Sally Dickman replaced Arboretum secretary Ms. Anne Switten in December. Esiquico (Chico) Narro, Gardener Lead, pruning instructor, garden consultant to the public, raconteur and gourmet cook retired in February, although he will continue to assist in the Arboretum's Education Program. He is replaced by V. Dean Powell who transferred from the campus ground maintenance staff. Will Danielson, Maintenance Leadman, replaced Al Hoveland as chief of the park department crew in late fall 1975.

The Arboretum has always been fortunate in attracting volunteer workers — men and women who are willing to join our staff as gardeners for the experience or for more altruistic reasons. Linc Donaldson and Peggy Porter are two such people who have given faithfully of time and energy.

Another group of young people has been working with the Arboretum's staff. Three students in the Seattle Public School's Work Training Program work part-time in the Arboretum learning gardening skills and attend classes the rest of the day. It has been a pleasure to have them working with our staff.

Operations

The university staff has been able to devote much more time to a variety of work directly connected with maintenance and care of the woody plant collections now that they have been relieved of the onerous chore of grass cutting and leaf raking. They have done much needed pruning and removal of unwanted brush and weed trees in various areas of the Arboretum. Most of the debris from this work was processed by a chipper borrowed from Pack Forest and the chips were either returned to the beds as mulch or stored for later use.

Disease and insect control remains a very time consuming chore. Autumn spraying of the Japanese cherries with copper has slowed the destruction caused by the bacterial cherry blight.

We still spray for tent caterpillars, spruce aphids and pineshoot moth, but we avoid general spraying as much as possible in order to avoid destruction of the predatory insects which feed on plant pests.

Weed control occupies most of our temporary summer labor's time. The annual treatments of Casoron, which most of the shrub beds receive, help in this respect. Mulching is also effective, and staff members spread over 250 cubic yards of mulch material last year. Our truck hauled most of it from private stables east of Lake Washington.

Another task which becomes more of a burden each year is the repair of the rusting water lines. Over 180 man-hours were spent in repairing leaks in this antiquated system during the year and there is no reason to believe that this situation will improve until it is replaced.

The program of replacing the cold frames continues. One set south of the greenhouse which was built to accommodate the many seedling rhododendrons raised after the 1955 freeze was removed. This area is being prepared for a small dwarf conifer display to be planted in the fall. During the summer a student from the College of Forest Resources is utilizing part of this cleared space to study the effects of pesticides on potatoes.

The park department staff built a rustic bridge over the stream in Woodland Garden, made a new set of steps leading from the Rhododendron Glen parking lot to the service road toward the west, and repaired several other steps which were in poor condition.

Planting

The main emphasis again this year was on completing or renewing older plantings since the present staff can barely cope with the existing collections. Several new areas were developed, however, where they were continuations of older plantings or were in especially prominent locations. A collection of primarily orange to yellow rhododendrons was set out on the bank northwest of Loderi Valley, improving the appearance of both the valley and Azalea Way. Another small rhododendron planting was established at the head of Rhododendron Glen, and the recently renovated pond at the foot of the Glen has been planted with dwarf or low-growing conifers and rhododendrons. Weeds had infested both areas and they were distinct eyesores.

The staff has moved nearly 40 large hollies (some up to 20 feet tall) from the nursery to the holly collection where they now line the west service road.

In all, some 100 rhododendrons and azaleas were set out as well as about 500 other plants of 165 varieties.

Educational Activities

Mr. Richard van Klaveren, the propagator, Mr. Narro and Mr. Joseph Witt, the curator, taught continuing education classes again this year. As usual, Mr. van Klaveren's propagation courses proved to be highly popular; all four classes were filled and had waiting lists of students. He also gave three nine-hour lecture-demonstration classes on house plants. In addition to two pruning courses, Mr. Narro presented a new class in Basic Garden Maintenance which was well received. Mr. Witt's Arboretum-In-Depth Tours were held in fall and spring.

The staff also gave lectures, tours and demonstrations to garden clubs and similar groups. A tape-slide show prepared to give publicity for the Union Bay plans was popular with various civic groups and was shown numerous times by a group of volunteers.

Funded largely by the Unit Council, the staff was able to attend a number of educational meetings and symposia. Mr. Narro and Mr. Fred Mauch represented the Arboretum at the regional meeting of the International Society of Arboriculture in Portland. Mr. Richard Hart, Ground Superintendent, and Mr. Mauch attended a course offered by Washington State University on pest control spraying. Mr. van Klaveren attended the Washington State Nurserymen's Association Convention and the International Plant Propagators Conference. Mr. Witt participated in the annual meeting of the American Association of Botanic Gardens and Arboreta in Philadelphia.

Other Activities and Projects

Mr. Witt and Mr. van Klaveren have been advising the staff of the Charles Lathrop Pack Forest concerning landscape improvements underway on that campus. The College of Forest Resources intends to develop a teaching arboretum for students using this facility. The new develop-

ment at Union Bay is still in the planning stage. The concept of a teaching and research arboretum on the Union Bay site has been approved by nearly all concerned university committees, but still awaits action by the Regents. A public hearing was held on the preliminary plans in March. The Master Plan prepared by the firm of Jones & Jones, landscape architects, should be ready this summer. Plant materials are being propagated in the Arboretum greenhouses for future use in both of these projects.

A display showing the many facets of the University's Arboretum program was included in the Horticultural Festival, June 2, 3 and 4, sponsored by the Northwest Ornamental Horticultural Society. The Arboretum exhibit, held in the IBM Building, included a model of the proposed Union Bay Arboretum, a series of display panels on Arboretum activities, as well as propagating demonstrations by Mr. van Klaveren.

Research

Aside from the usual plant introduction and testing which is a continuing project, a frost hardiness program was initiated in the fall of 1975 and continued into spring 1976. A more complete report on its scope was given in the Fall, 1975, *Bulletin*. The results of the preliminary work have been exciting and potentially very useful for screening possible new plant introductions into the Pacific Northwest. The research will continue next season supported by a grant from the Arboretum Foundation.

The Arboretum's collections frequently serve as a resource for other plant scientists. For example, plant parts or other specimens were sent to the University of Kalyani, West Bengal; Bucknell University, Lewisburg, Pennsylvania; The National Arboretum, Washington, D.C.; and the Central Research Center, Ottawa, Canada.

Seed and Plant Exchange

The Vivian Mead Unit distributed seeds from our 1976 Seed List, mailing 3,473 packets to 220 institutions throughout the world. This represents a marked increased over the number of seeds distributed last year. In return, the Arboretum received 801 kinds of seeds, cuttings or plants from 129 sources. This figure has also risen and reflects in part the increased use of our greenhouse facilities in raising plants for future use in Pack Forest and Union Bay.

Weather

This year has been mild with nearly normal precipitation. The coldest temperatures were 20°F in November 1975 and February 1976. The warmest was 88°F in July 1975. Spring was very slow in coming with generally cool and cloudy weather resulting in a much extended flowering season. At one time flowering was two to three weeks later than normal. The weather record is tabulated below.

WEATHER

1975	High	Low	Precipitation in inches
June	86	42	1.23
July	88	49	0.12
August	84	46	3.62
September	86	43	T
October	78	32	8.57
November	66	20	6.64
December	56	26	7.10
1976			
January	60	27	4.37
February	57	20	4.76
March	60	28	3.66
April	86	28	2.22
May	83	38	1.91
		TOTAL	44.20

(20-year average: 40.91)

Traffic

Traffic through Arboretum Drive East increased approximately 50 percent over the average of the past two years probably due to the closing of East Prospect Street west of the Arboretum. When this street, traditionally used as a route from Empire Way to the University, was closed, many drivers chose to use the Arboretum's roads. The increased traffic flow is of some concern since Arboretum Drive East is not designed to carry a heavy load. The traffic count is given below.

TRAFFIC COUNT
on Arboretum Drive East

1975		1976	
June	12,857	January	7,146
July	12,629	February	10,600
August	13,605	March	12,559
September	12,961	April	20,590
October	9,746	May	23,611
November	8,135		
December	5,314	TOTAL	149,753

ARBORETUM FOUNDATION ANNUAL REPORTS

The following reports have been written for inclusion in the Bulletin *except for an edited version of the Unit Council report which was presented at the Annual Meeting and is on file in the Foundation office. The Treasurer's report is to be found inside the back cover in the form of the audit as prepared by Price Waterhouse & Co. Instead of a report by the Nominating Committee, a complete list of officers and directors of the Foundation is presented inside the front cover.*

PRESIDENT'S REPORT

The past year has brought both progress and frustration for the Foundation. It may be helpful to take a look at some of the more important areas of concern as an overview of the 1975-76 year.

The most disheartening factor to me has been the extremely slow progress made by the Arboretum Steering Committee, composed of representatives of the City of Seattle and the University of Washington, together with one member selected by the Governor.

The mere presence of such a committee, specifically charged with defining and planning the future development of the Arboretum in Washington Park, should be a most encouraging factor. On the other hand, the delay in formulating those plans is subjecting any future development to rapidly escalating costs. While it appears that the pace of progress is improving, most other improvements in the Arboretum must necessarily await the definition of an objective.*

Despite these problems, the physical condition of the Arboretum has improved under the joint city/university maintenance program, and we have survived an extremely difficult budget period with good result to date.

Public use of the Arboretum has increased, and it is most encouraging to see that it is continuing to grow in public interest.

Our contributions in money and in such public services as volunteer labor, tour guiding, horticultural classes and other educational activities, as well as support for botanical research related to the Arboretum, have remained at a high level over the past year.

Simultaneously, the Foundation has retained its membership and financial strengths, and is in position to give prompt and substantial help once a future course of action has been fixed.

While much remains to be done in the development of joint understanding between the Foundation and all other organizations interested in the Arboretum, I am encouraged by the fact that there are areas of agreement in objective and that much of the friction that has occurred in the past would appear, on close inspection, to be related to emphasis and procedure, rather than to basic direction.

Your support of the Arboretum during the past year has been both unselfish and effective.

Thank you.

N. STEWART ROGERS

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*Those who are concerned with the well-being of the Arboretum will be pleased to know it was announced just before press time that the Arboretum Steering Committee has agreed to hire a design consultant to define the future of the Washington Park Arboretum. This is the first step in resolving the impasse which has characterized the efforts of the committee during the past year.

UNIT COUNCIL

The 1,476 members of the Arboretum Foundation, who are active in the 74 units comprising the Unit Council, like to think of themselves as a group of dedicated volunteers, whose main purpose is to give support to the University of Washington Arboretum, and thus help in its future growth and development.

Our four Unit Council meetings had a new format this year. Each meeting included an interesting horticultural report and ended with a short program and speaker. The Education Chairman arranged for four fine presentations: The Alpine World of the Pacific Northwest, a grafting demonstration given by Mr. Richard van Klaveren from the Arboretum greenhouse, an indoor plant workshop in January and a lecture by Jean Witt on flower pigmentation.

One Unit Council meeting was a 25-year anniversary celebration, honoring 178 individuals and 18 units that had been in existence since 1951 or earlier. With lots of reminiscing and renewing of old acquaintances, we had a GRAND time!

There is a niche for everyone in our Unit Council family. If your specialty is rhododendrons, there is a study group, recently named the Mae Granston Rhododendron Study Group, that you can join to learn everything there is to know about them. In fact, this group reached a new peak of achievement this year with the advent of their "Late, Late Rhododendron Show" in which members of the group and the Foundation entered their own trusses. Aside from meetings of rhododendron enthusiasts, we also hold study groups on rock gardens and Northwest native plants. The latter has adopted the name May Guy Northwest Natives Study Group and has just scheduled an intensive class for its more advanced members.

Some of us attended a ten-week botany course taught by Dr. Janet Hohn at the University of Washington during which time we covered a great deal of material and sampled the art of keying in Hitchcock's *Flora of the Pacific Northwest.*

Every Tuesday morning one can find hardworking women taking cuttings in the greenhouse, transplanting and learning about all phases of gardening. Our greenhouse has become an important contributor to the annual Plant Sale, since choice cuttings are raised from plant material from our own members as well as from the Arboretum itself. Over 2,000 plants were sold this year at the Plant Sale from the greenhouse alone.

The Explorers, an instructional walk through the Arboretum, is a service the Unit Council performs not just for its members but for the general public as well. Every fourth Wednesday of each month during the year (except for December), this intrepid group left the parking lot and ventured forth rain or shine for two-hour walks, usually led by our faithful Bob Van Denburgh.

Another public service is the Guide Program. Volunteers conduct school children and interested adult groups through the Japanese Garden and the Arboretum. We added 11 new guides to our list of 22 regulars this year.

The School Program visits classrooms with native plant material for children of all ages. The Program has expanded to take in visits to Children's Orthopedic Hospital, Group Health and Arden Home. Giving instruction in care and identification of plant material brings a touch of the outdoors to those confined to their beds.

The Herbarium Committee has the long-range plan of collecting and mounting a specimen of each of the various examples of plants found in the Arboretum. To date, Joe Witt has sent 117 duplicates to The National Arboretum in Washington, D.C.

Our 1976 fund-raising projects were the Plant Sale and the Fall Bulb Sale. Last September, $12,000 from Plant Sale profits were turned over to Mr. Witt to be used at his discretion in the Arboretum. The Plant Sale was a huge success again this year with the final gross income of over $34,000. Our new informative plant list in booklet form was sent out in March and by the end of April, 175 people had pre-ordered 1,878 plants.

We added two new departments to the Plant Sale this year — the Bicentennial Department, featuring red, white and blue combinations of annuals in planters, and door prizes which were presented to lucky ticket holders every hour. The Bicentennial Department proved so popular that we can hardly wait to do it again in 200 years. With 18 plant-oriented departments and 15 service departments, over 500 people joined together to make this one of the best plant sales ever.

The Bulb Sale grows bigger every year with the fall 1975 total net profit at $4,500. Through bulb sale profits we have purchased a new collator machine to help assemble plant lists for both sales. The Unit Council bulb bed near the Arboretum office tests new selections for inclusion in the bulb list; it is a lovely sight in April, with over 400 varieties in the display.

As usual, this year we set aside one day in the spring to put on our craziest hats and pick up our garden tools to tackle the weeds and debris in the Arboretum. When lunchtime arrived, nearly 150 tired workers gathered at the parking lot for refreshments and a hat parade for which prizes were awarded. The units who were not able to work donated a whopping $583 to pay hired help to finish where volunteers left off.

My thanks goes to all members of the Unit Council Board, who have been such faithful, loyal help to me this year, as well as the many units who are always ready to help out whenever they are needed. A special thanks to the person-

nel in the Arboretum and Foundation offices: Joe Witt and Sally Dickman, and Marilynn Holm and Candace Lawson.

Thanks also to Mr. Van Denburgh, our fearless leader on Explorer walks and to Mr. van Klaveren, who is never too busy to be of help to the greenhouse crew. Our gratitude to Pablo Abellera who works so hard selling his dahlias at the Plant Sale and then turns around and donates all the money to the Arboretum.

It has been a privilege to be Unit Council Chairman this year. I am looking forward next year to working with all of you to help make our Arboretum, a rare and special educational and horticultural asset, fully appreciated by the surrounding community as well as the whole Northwest.

LEE CLARKE
Unit Council General Chairman

PLANT SALE

The 1976 Plant Sale is a matter of history. The Plant Sale was blessed with fantastic chairmen, superior assistants, undeniably loyal support and even good weather. Our final gross was $34,557, and the net is $18,253. Each and everyone of you deserves your own bow.

This was not a plant sale solely of 1976; it was based on an accumulation of past experience. The problems of entry are horrendous. The limited facilities, parking, crowds, as well as the long lines at the cashiers, can be discouraging for most of us. In the past, we have tried to foresee and overcome each potential problem, and we have done it with excellence. Why else would our customers return?

We have a reputation that took a long time to build and we need to reflect on why we have the customers we have. The word is out that we have unusual and hard to obtain plant material, so the collector comes. We have a nice variety of well-grown material, so the experienced gardener comes. We also have knowledgeable people working throughout the various departments so the new gardener comes.

There are a lot of new gardeners, and many not so new gardeners, who believe that we can answer a multitude of questions. I think it is important that we supply the brain power to answer their needs. More happy customers make more happy supporters. Future chairmen take heed — homework is the name of the game. Study, and don't disappoint our customers.

There is more to a plant sale than meets the eye. The plant departments receive all the fanfare. Out of 33 departments this year, only 18 were directly plant-oriented; the others were service-connected and necessary. To our working membership I would suggest that for every year of plant-oriented work, think about devoting a year or two to a service department; branch out into another plant department, and broaden your exposure to the plant kingdom as well as to the scope of the whole function. You will find both most rewarding.

The 1976 Plant Sale has become history. I hope it is a living history in your garden and the gardens of new friends for the Arboretum.

MARY ELLEN MULDER
Plant Sale Chairman, Spring 1976

DON'T FORGET THE SPRING PLANT SALE!

Now is a good time to plan for your donations, dig and establish them in containers suitable for selling.

MEMBERSHIP IN THE ARBORETUM FOUNDATION
is not only one of the best ways to support your Arboretum; good fellowship, educational benefits and subscription to the *Arboretum Bulletin* are among the bonuses. Information is available by calling the Foundation Office, 325-4510.

Photo: Brian O. Mulligan

Weigela maximowiczii

FROM A COLLECTOR'S NOTEBOOK

BRIAN O. MULLIGAN

1. *Weigela maximowiczii*

In May various kinds of Weigela shrubs flower in the gardens and parks of the Puget Sound region and elsewhere, displaying shades of pinks, or less frequently, whites and reds. Dr. R. A. Howard of the Arnold Arboretum lists more than 100 named garden forms or hybrids in a checklist published by that arboretum (*Arnoldia*, Dec. 1965, Vol. 25, nos. 9-11). However, out of more than 50 forms of *Weigela* tested at the Arnold Arboretum, Dr. Donald Wyman cites in his *Shrubs and Vines for America* only 10 forms he considers suitable for use in the Boston area. These have a flowering period from mid- to late May.

All species of *Weigela* are native to eastern Asia, with the great majority coming from Korea or Japan. Two of the ten Japanese species, *W. middendorffiana* and *W. maximowiczii,* are notable for possessing yellow flowers. While the former is found also in Manchuria, northern China and Japan, the latter is native only to the mountains of central and northern Honshu, the largest island of Japan. Although *W. maximowiczii* was introduced to North America only in 1915 and is still rare in botanical gardens and arboreta today, the plant was first described (as a variety of *W. middendorffiana*) in an English botanical journal in 1878; thus it has been known to western botanists for almost a century.

In the autumn of 1969, Mr. B. LeRoy Davidson of Bellevue, Washington, brought back from Japan a considerable variety of native plants, both herbaceous and woody. He kindly presented to us for our own garden a seedling of *W. maximowiczii,* which we duly grew on, planted out and had the pleasure of seeing flower very sparingly in 1974. It again bloomed in the following year but much more freely in 1976, when the photograph was taken. The pale yellow flowers, having the usual funnel form found in this genus, with a distinct swelling at about mid-

length, are produced in pairs at each joint on shoots made the previous year. These are 1½ inches long, with a distinct and noticeable orange spot on the lower lip, which is doubtless a landing guide or signal for pollinating insects.

The ovate leaves, 2 to 4 inches long by 1¼ to 2 inches wide (wider on vigorous young shoots), are produced in opposite pairs along the branches, having an acuminate apex, a rounded base, and no appreciable petiole. The dark green upper surface is distinctly furrowed (rugulose) and on the paler lower side the veins are raised; both sides are rather roughly hairy (strigose), especially along the seven or eight principal pairs of veins that curve upwards before reaching the finely serrulate and ciliate margin. The stems are angled, and pubescent chiefly along these angles.

Our plant, now about six feet in height, does not seem to require a great deal of space as it has an upright habit. No seeds have been produced but summer cuttings should provide a means of propagation, especially under mist.

The Arboretum possesses two plants received from the U.S. Department of Agriculture in May 1953, which had been imported from England. These are still in the nursery area and are 8 to 10 feet tall. The name *Weigela* was given by Carl P. Thunberg in 1780 to commemorate Professor C. E. von Weigel of Greifswald, Germany. It should not be spelled *Weigelia* as is sometimes done.

2. *Rosa gallica*

Linnaeus named *Rosa gallica* in 1753 for the country in which his herbarium material was collected. It is not solely indigenous to France, however, and is not now believed to have originated there. Since it is one of the basic parents of our modern roses, I was particularly interested, not to say excited, to see in June 1973 a flowering example of *R. gallica* in the town of Versailles, France. It was growing in the garden of the late Professor George Morel, a plant physiologist and botanist of international reputation. It had been collected from wild plants somewhere in the south of France, the precise locality unknown to me.

Although the plant was only 18 inches high and about 30 inches wide, it carried a number of bright rose-pink fragrant flowers, each 2¼ inches in diameter. Like our *R. nutkana* and the European *R. pimpinellifolia (R. spinosissima)*, it spreads by underground stems so that propagation by that means should be relatively easy.

R. gallica seems to have potential value as a

Rosa gallica

Photo: Brian O. Mulligan

ground cover. O. Nilsson reports in *Flora of Turkey* (Vol. IV, University of Edinburgh, 1972) that it grows in dry meadows, on slopes and on dunes. One can imagine that a large patch of this rose in bloom would be an eye-catcher on a roadside bank. Information from anyone who has seen it under such conditions, either wild or cultivated, would be welcomed. Unfortunately, the seeds that Professor Morel sent me failed to germinate.

According to *Flora Europaea* (Vol. 2, University of Cambridge, 1968), *R. gallica* is now considered to be native to Belgium through France and central Europe to Greece, Turkey, Caucasia and Iraq. Probably, however, it originated in western Asia or Turkey, spreading into southern Europe at a very early date, and then moved slowly northward. Discussions on this question and the history of the Gallica roses may be found in Dr. C.C. Hurst's article in the *Journal of the Royal Horticultural Society* (Vol. LXVI, March 1941) or in G.S. Thomas' *The Old Shrub Roses* (1955 or 1966 editions). Both can be found in the Arboretum library.

3. *Schisandra rubriflora*

In 1956 the Arboretum obtained seeds of an unusual deciduous, woody, twining plant, *Schisandra rubriflora*, from the garden of Captain R. G. Berkeley of Spetchley Park, Worcester, England. In June 1959 two plants were set out on the south side of one of the lath houses. The first flowering, which appears to have been in May 1963, produced only male flowers; female flowers appeared on the second plant a few years later. The species of this genus are generally dioecious, bearing flowers of one sex only on each plant.

Schisandra rubriflora possesses rather broadly lanceolate leaves, about 2½ to 3½ inches long and 1 to 1½ inches wide, irregularly serrated, acuminate at the apex; the underside is paler than the upper, with raised veins, and the prominent bright red petioles, ¾ to 1¼ inches long. On the smooth young shoots the leaves are somewhat longer acuminate and narrower, much less sharply toothed; the stalks are only about one half inch in length.

The flowers, produced singly from the leaf axils in May, hang from stalks 1 to 1½ inches long and are conspicuous for their five or six thick, red tepals as well as for the prominent cone of stamens in the center of the male flowers. In the bud stage they have considerable resemblance to a ripening cherry. The photograph was taken at the Arboretum on May 9, 1969.

Staminate flowers of *Schisandra rubriflora* Photo: Brian O. Mulligan

If the female flowers are pollinated, they develop into pendulous, cylindrical bunches of small red fruits attached to a central axis from two to four inches long, quite an unusual development amongst our hardy, climbing plants. Although the female plant continues to grow vigorously, the male plant at the Arboretum died about 1972, and consequently no fruits have been produced in recent years.

This genus was originally founded on a plant from southeastern United States, *S. glabra (S. coccinea)*, the Carolina magnolia vine or wild sarsparilla. *S. glabra* grows from Texas and Arkansas to Florida and South Carolina. It has not yet been tested in the Arboretum.

Of the approximately 12 species in the genus, all are Asiatic except *S. glabra*. They are found wild from the western Himalaya through China to Korea and Japan (three species), to Java and Sumatra. Previously included in the family Magnoliaceae, they are now placed in Schisandraceae, together with *Kadsura*, a genus of evergreen climbing plants from eastern Asia. *K. japonica* is sometimes grown in warmer climates than our own.

Schisandra rubriflora is native to the province of Szechuan, western China, whence it was introduced to the Arnold Arboretum by E. H. Wilson in 1908. It had been discovered some 40 years earlier by Father Armand David and again in the 1880's by the Rev. Ernst Faber. It is certainly worthy of wider cultivation than it has received in recent years, and is, perhaps, one of those cultivated plants which we should take care to preserve for the future. ♠

BUTTERFLIES IN THE ARBORETUM*

BASTIAAN J. D. MEEUSE
(with collaboration of Daniel Carney)

The colors and scents of butterflies

Poetic people think of butterflies as the flowers of the sky, associating them almost automatically with something colorful. The visual effect is brought about by thousands of microscopically small scales on the surface of the wings, characteristic for the class of butterflies and moths, Lepidoptera — literally "scaly wings." The scales, arranged in rather straight rows, overlap one another in much the same way as the tiles on a roof (P. 18, Fig. A). This is made possible because an individual scale is quite flat and somewhat racket- or paddle-shaped, with a short stalk that fits into a minute socket (Fig. 1). The scales' role in the process of flying is negligible, but as units which cooperate visually in creating the sophisticated "painting" which we call a butterfly's wing, they can not be surpassed.

Scales produce color in more ways than one; either they contain certain pigments or their fine structure generates color effects in much the same fashion as a soap bubble or a thin film of oil on water. Colors produced in the latter way are called interference colors. They will predictably manifest themselves when the wall of the scale is composed of a number of exceedingly fine films, separated from one another by material of a

*This is the second of Dr. Meeuse's two-part article which began in the preceding issue of the *Bulletin*.

Fig. 1
Scent scale and two ordinary scales of a meadowbrown butterfly *(Eumenis)*. Size of scent scale 0.3 to 0.4 mm.

Drawing: B.J.D. Meeuse

slightly different refractive index. However, the colors may also be due to diffraction, a phenomenon which is based on the fact that the surface of each scale bears minute parallel ridges. Especially in certain species of blues, a great deal depends on the angle under which light hits the wings, and it is, therefore, not surprising that the effects vary when the position of the wings or of the whole body changes. Most of the blue and metallic shades of butterflies (for example, in the large, stunningly colored *Morphos* from Central and South America) are structural in origin. Color-producing scales are crucial in creating the patterns and effects so important in mating, camouflage and mimicry.

The males of some species, in addition, have scent scales or androconia, highly specialized little organs that distribute the scent produced by gland cells, which are present in the wing membrane. Androconia are more slender than ordinary scales. Each has a short stalk attached to a hollow disc which in turn is connected to the gland cells. The main body of the scent scale is hollow or at least spongy so that it can transport the perfume to its plume-bearing tip where the secretion evaporates. A scent scale can thus be compared to a self-feeding paintbrush.

Scent scales may be scattered among the ordinary scales, as in many of the whites, or they may be grouped together in special patches on the upper surface of the front wing, called scent brands, as in some of the fritillaries, meadowbrowns and woodnymphs (Fig. 2). Males of species with distinct scent brands go through a special courtship behavior which culminates in their assuming a position opposite the female; a deep bow then establishes contact between the female's antenna (the center of her sense of smell) and the scent brand, thus stimulating the female to accept the male. Since the males of the *Oeneis* species (Nevada arctic, Chryxus arctic and Melissa's arctic) demonstrate this behavior superbly, it is unfortunate that they do not occur in the Arboretum. We must content ourselves with getting a whiff of some of the others. Here are some of the aromas which butterfly enthusiasts have recorded:

Western tiger swallowtail, *Papilio rutulus:* sweet and flowery, with a suggestion of spice.

Spring azure, *Celastrina argiolus:* crushed violet stems.

Fig. 2. Male and female of the Nevada arctic *(Oeneis nevadensis)* showing scent brands on front wings of male (left). Photo: B.J.D. Meeuse

Alfalfa sulphur, *Colias eurytheme:* heliotrope.

Common sulphur, *Colias philodice:* sweet hay.

Cabbage white, *Pieris rapae:* mignonette and sweet briar.

Veined white, *Pieris napi:* lemon verbena.

Meadowbrown family: chocolate cream, musk, sandalwood and the odor of old cigar boxes.

The shape of scent scales is quite distinctive. In some cases, one can key out a butterfly species by observing a single scent scale under the microscope! There are instances where spring and summer generations of a butterfly species can be distinguished by differences in the androconia.

Butterfly pigments

In most butterflies, color is not caused structurally but by the presence in the scales of certain pigments varying widely from one another in their chemical structure and biological origin.

Caterpillars obtain at least one group of pigments, the flavones, directly from the leaves of their food plants. Flavones are responsible for certain flower colors ranging from ivory to yellow. When combined with ammonia, they characteristically produce compounds of a much deeper shade of yellow. This is an extremely sensitive reaction, which produces startling results in a few of the whites and on the underside of the wings of some blues.

In most whites, however, the natural color is due to the presence of two most remarkable compounds not immediately derived from food plants: leucopterin, which is white, and xanthopterin, which is yellow. Soon after the isolation and chemical characterization of the pterins, it was found that folic acid, a compound first discovered in spinach leaves (*folium* means leaf), has a pterin as one of the building blocks of the molecule.

Fig. B. Caterpillar of pine-white *(Neophasia menapia)*. Notice camouflage and visual breaking of outline. Photo: Sharon Collman

Fig. C. Eggs of pine-white *(Neophasia menapia)* showing camouflage achieved by arrangement and green color. Photo: Sharon Collman

Fig. A. Scales on wing of *Papilio oregonius*. Photo: Sigurd Olsen

Fig. D.

Fig. E.

Fig. F.

Figs. D-G. Various stages in the life of Lorquin's admiral *(Limenitis lorquini)*. Clockwise from left: caterpillar, chrysalis, butterfly hatching and resting adult. Photos: B.J.D. Meeuse (Fig. D.); Sharon Collman (Figs. E.-G.)

Fig. G.

F. I. Pale tiger-swallowtail *(Papilio eurymedon)* on flow-
e of mountain balm *(Ceanothus velutinus)*. Photo:
B.D. Meeuse

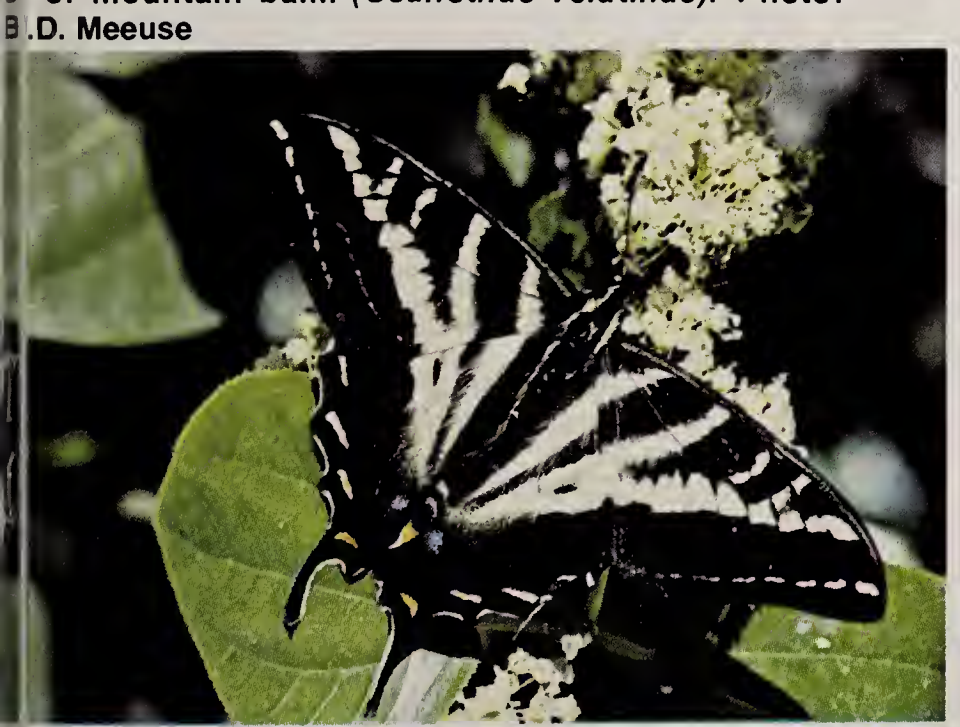
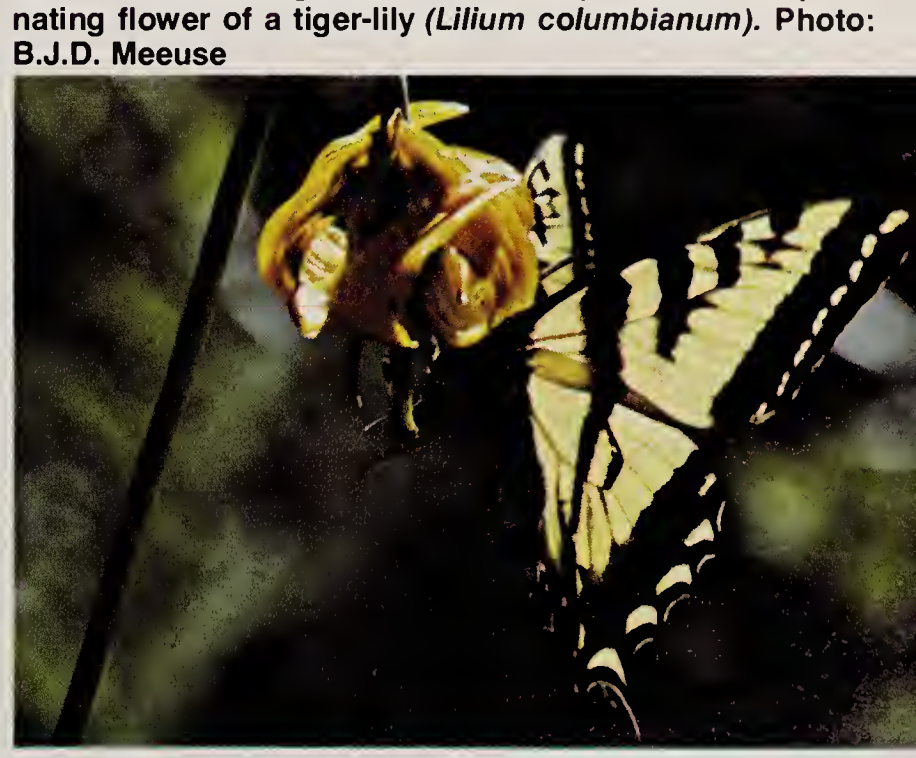


Fig. H. Western tiger-swallowtail *(Papilio rutulus)* pollinating flower of a tiger-lily *(Lilium columbianum)*. Photo: B.J.D. Meeuse



Folic acid can legitimately be considered a vitamin. It is beneficial to a wide range of organisms and even to certain fast-growing cancer cells, especially those involved in leukemias. One can throw a monkey wrench into the metabolic machinery of such cells, and thus essentially condemn them to death, by providing them with compounds which in their chemical structure are fairly similar to the natural pterins but still not sufficiently similar to really substitute for them. Examples are aminopterin and amethopterin, easily synthesized industrially and thus relatively cheap; these have indeed been found to be clinically effective in slowing down leukemias and in halting the growth of certain types of cancer cells.

It is a most happy thought that years have been added to the lives of many leukemia patients by the research that was unexpectedly triggered when a butterfly-loving chemist decided to indulge his naive curiosity about the wing-pigments of Lepidoptera! Also, this felicitous development has demonstrated once more how much can be achieved when researchers of established merit are given the financial and psychological support to follow without interference their own scientific inclinations — even though at first blush their projects may seem somewhat harebrained.

The brown and black colors of butterflies are caused by the group of pigments called melanins, which typically are black as the name implies. Melanins are responsible for the color of many beetles and flies, warts, dark human hair, and the dark skin of southern human races. However, melanin formation always starts with the oxidation of very simple, usually colorless compounds such as the amino acid tyrosine. On the long chemical pathway to melanins living cells will first produce compounds that are red, then brown, and finally black. The orange or red spot which some of our swallowtails sport near the "tail" can thus be considered a protomelanin.

Melanin formation is a temperature-sensitive process. In a butterfly species having more than one generation per year one can therefore expect considerable differences in color pattern between the spring and summer generations (Figs. 3 & 4). Sometimes the generations vary so much from each other that in the past they have been described as separate species! It is interesting to experiment in the laboratory with chrysalids that are especially temperature sensitive; I strongly recommend those of Milbert's tortoiseshell (*Nymphalis milberti*) as guinea pigs.

Some butterfly species show a gradual change in color with age. For example, immediately after a painted lady butterfly *(Cynthia cardui)* has hatched, its wings are suffused with a lovely salmon-pink flush. This gradually fades in a few days to a much duller brownish color. However, exposure of a faded specimen to chlorine vapors restores all the beauty of youth; one can actually see the warm salmon hue flooding back across the wings! Chlorine treatment will also remarkably intensify the red colors of other vanessids such as the red admirals and the tortoiseshells.

Protective devices

In all stages of their development, butterflies employ visual devices to protect themselves against their enemies. We have already indicated, in the example of the mourning-cloak, that protective devices fall into two main categories; the concealing (or cryptic) and the warning types. Especially in the caterpillars there is so much delightful variation and sophistication in the methods employed that the study of these animals should be made a must for all budding painters and illustrators.

A general resemblance in color between a caterpillar and its background undoubtedly helps to make the animal less conspicuous. However, because caterpillars are shaped like sausages, even one of a uniform green color sitting on a green leaf would generally be far from invisible; light coming from above would make their backs appear light green and their bellies dark, causing them to be easily spotted by predators. In actuality, when we keep green caterpillars in diffuse light, the back is objectively darker and the belly lighter. In the field this difference in shade leads to a nearly complete disappearance of the impression of roundness; the animal which has thus been "flattened" by the natural illumination can now really blend in with its background. The principle involved in this method of concealment, also employed by fish, is known as countershading or Thayer's principle.

Some species of caterpillars with dark green bellies and light green backs initially were thought to be an exception to the rule until it was found that under natural conditions such cater-

pillars have the habit of sitting on their branches in an upside down position. This, of course, renders them invisible too. In general, the behavior of animals with concealing coloration is always such that the camouflage effect is maximized.

In other green caterpillars, especially in the group of the Lycaenids (the blues, hairstreaks and coppers) we see another cryptic device — genuine flatness; they sit on a leaf or stem like limpets. Their visual disappearance is made well-nigh perfect because they have the shape of a woodlouse or flat cockroach, the result being that the edges of their bodies seem to pass imperceptibly into the surface of the leaf.

In still other caterpillars, resemblance to the background is achieved by a disruptive or obliterative pattern. For example, a single bold stripe or a system of stripes seems to divide the body into a number of separate parts, each of which can then be identified with a different part of the environment by predators or people. Caterpillars of the pine-white *(Neophasia menapia)* (P. 18, Fig. B) beautifully exemplify obliterative pattern. In the late summer months these butterflies are commonly found on the University of Washington campus and can be seen frequently in the Arboretum. Their caterpillars are gregarious and are found not only on pines but on other conifers as well. They are dark green with lengthwise white stripes on back and sides. Their position among the needles is always such that the concealing effect of color pattern is virtually complete. Perhaps the most beautiful example of disruptive coloration is displayed by some anglewing caterpillars such as those of the satyr (*Polygonia satyrus*). The fully grown larva is so dark as to be practically black but with a peculiar saddle-shaped patch of a dazzling white color along the back, which causes the animal to fall apart visually; enemies will no longer see it as a single edible morsel or unit.

The caterpillars of swallowtails display a special defense-mechanism. When disturbed they push out a fleshy, forked organ normally retracted in a pouch behind the head (Figs. 5 & 6). This organ, the osmaterium, produces a strong unpleasant odor differing from species to species; in some it is vaguely reminiscent of pineapple, in others of guava, etc. In at least one case isobutyric acid has been found to be a major ingredient of the odor. The scent-fork, sometimes shot in and out rapidly like the tongue of a serpent,

Figs. 3 & 4. Spring (left) and summer (right) generations of one of the whites *(Pieris beckerii,* above) and of a Lycaenid *(Celastrina pseudoargiolus,* below) illustrating how melanin formation varies with the season. Photos: G. Pirzio-Biroli

is quite likely to give a pecking bird second thoughts about the animal which it set out to eat.

Chrysalids of our native butterflies are usually cryptic, often resembling a withered leaf in shape and color. The pupae of most of our vanessids (such as the painted lady) have golden or silver spots which break up their shape effectively. The golden "nailheads" of the monarch's jewel-like green chrysalids have the same function.

The chrysalids of the pine-whites, other whites, swallowtails and vanessids adopt the color of their background. For instance, pine-white pupae found among pine needles tend to be green, while those attached to the bark of their host tree are brown. The color of a chrysalis is determined during a sensitive period, during a few hours just before the caterpillar pupates.

How does the animal "determine" the best color for its chrysalis? Sir Edward Poulton, who investigated the matching phenomenon in England around the turn of the century, came to the conclusion that the color of the light impinging on the pupating caterpillar is decisive. Larvae of a small tortoiseshell produced pale pupae when exposed to yellow light, whereas members of the same brood formed blackish pupae in blue light. Poulton believed that a direct light effect was responsible, working on the whole body surface of the caterpillar and not controlled secondarily through the eyes. He also found that the response to the environment did not change when

Fig. 5. Caterpillar of a swallowtail *(Papilio zelicaon)* with scent fork hidden. Photo: Sigurd Olsen

the ocelli — the simple eyes of caterpillars as opposed to the beautiful, multi-faceted compound eyes of the adult — were covered with black varnish. However, L. Brecher, who repeated these experiments in Germany in the early 1920's with larvae of the large cabbage-white butterfly, came to an entirely different conclusion. When she covered the ocelli with blue varnish, the dark type of pupa was produced, regardless of the background; application of yellow varnish to the ocelli always gave light-colored pupae. In this case, then, the eyes seem to "record" the color of the environment, leading in some mysterious fashion to formation of the right types of matching pigments. This topic is clearly in need of further investigation.

Raising butterflies in captivity

Few hobbies are as rewarding as the raising of butterflies in your home or lab, where you can watch the process of metamorphosis at close range. However, the beginner is well-advised to start with "easy" species, such as red admiral, painted lady, mourning-cloak, the cabbage whites or some of our swallowtails. By following an ovipositing female in nature, one can often obtain eggs attached to their food plants. Or, one can place a gravid female with the food source in a covered aquarium or a big muslin bag. This works well for the spring azure *(Celastrina argiolus)* and for some of our whites and nymphalids. With painted ladies, we have found that males and females mate readily in an aquarium provided with the caterpillars' food source, for example, mallows.

Whether raising butterflies from eggs will be successful depends to a large extent on the life history of the species involved, i.e., on the manner in which it hibernates. If one is dealing with a fast-growing species that has two or more generations a year, and is fortunate enough to have obtained eggs of the generation that does not hibernate in the larval or chrysalis stage, one is, of course, "in clover." If the species or the generation passes the winter as a chrysalis, one still has reason to be optimistic, provided one keeps the chrysalis cool and protects it from dehydration.

The caterpillars of many moths and the larvae of a few butterfly species pupate in the ground. In such cases, place sand or garden soil in the jar or container so that at the appropriate time the caterpillar can find a suitable spot. Do not disturb the soil and keep it barely moist — almost as dry as the soil in a cactus pot in winter — to avoid growth of mold.

The best way to get chrysalids through the winter is to keep them outside in an open shelter with northern exposure. If some of the chrysalids do not hatch the following spring, one should not assume that they are dead; especially among moths, the adults may not appear until the second or third spring (or even summer) rolls around.

It is often much more difficult to get caterpillars through the winter. The coward's way out is to keep them in your garden on their food plant with a muslin bag tied around the branch to protect them against birds.

Rather than to start out with eggs, one can try to find the caterpillars in nature. This, however, requires not only knowledge of their food plant but also a sharp eye for well-camouflaged caterpillars. In those cases where the animals depend on countershading or inverse countershading, it often helps to turn over the twig of their food plant. At home, caterpillars are best raised in large jars, preferably as wide as they are tall. Cover the bottom with dry sand and include a small flask of water with a leafy branch of the food plant. Cover the neck with muslin. Since caterpillars' droppings invite the growth of mold, some butterfly fanciers prefer to keep the jars

upside down and to avoid water altogether. In this case, of course, one cannot use sand and must replace the food supply frequently. Rest the inverted jar on one side on a small block of wood to permit good air circulation. The droppings that fall down on the muslin dry out quickly and mold growth is reduced to a minimum.

Raising the caterpillars of blues may bring special — and very intriguing — difficulties. The young stages often display strong cannibalistic tendencies. Furthermore, the larvae of other species enter into symbiotic relationships with ants, upon whom they may become dependent for their well-being — at the penalty of death! On the seventh abdominal segment, these caterpillars have a special gland that secretes a sugary fluid. Ants, which crave this food, attend their caterpillar "cattle" and probably protect them to some extent against parasites and other creatures. An example is the silvery blue *(Glaucopsyche lygdamus)* which is quite common in the state of Washington in a variety of habitats, including the Arboretum; no less than three species of ants have been observed attending these caterpillars! In other blues, the sugar-producing and carnivorous habit are combined. Their first stages develop normally on the plants on which the adult females lay their eggs. Ants already visit the caterpillars here. After a few molts, the latter become inhabitants of the ants' nests. The caterpillars feed on the brood of their hosts, while the ants continue to "milk" them. It has been observed that some lycaenid caterpillars die when ants are prevented from attending them on their food plants. Clearly, more than just the presence of their plant hosts is required for the survival of such butterfly species.

Epilogue

It is obvious that a person interested in living creatures would be hard pressed to find a group of animals offering a better opportunity to combine business and pleasure than the butterflies. True, their economic significance is minor, but what marvelous scientific and artistic insights they have given us, and what interesting avenues have been opened up by their study! The beauty of the present situation is that challenge and mystery remain, and that observant amateurs, even the casual stroller in park or arboretum, can make splendid contributions. At the same time, may they never cease to think of butterflies as the beautiful flowers of the sky.

Fig. 6. The same caterpillar with scent fork extruded. Photo: B.J. D. Meeuse

Acknowledgement

The author wishes to express his appreciation to Mr. Sigurd Olsen for his unstinting help in obtaining photographs for this article.

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Lawrence J. Michaud

We are saddened to have to report the death of Lawrence Michaud at Duvall, Washington, on July 14, 1976, after a prolonged and crippling illness.

Mich, as he was always known to his friends and fellow workers, was born in Montreal, Canada, in May 1899. At the age of 20 he moved to the state of Michigan and two years later to Spokane, Washington, where he gained experience in the raising and growing of plants in the greenhouses of three different nursery firms.

Here he also met and in 1926 married Frances Craig. They had a son and a daughter and later 10 grandchildren, with whom they were able to happily celebrate their 50th wedding anniversary in January this year.

In 1942 they moved to Seattle, where he worked for the Boeing Company for some 2½ years. He was persuaded to apply for the vacant position of nursery foreman at the University of Washington Arboretum in April 1945 and was duly hired by the late John Hanley.

His work involved not only raising many hundreds of plants annually from seeds sent from other institutions and correspondents throughout the world but also propagating others of special merit by cuttings or grafting. Many of the large tree magnolias now growing in Loderi Valley and elsewhere were grafted by Mich at this time from scions received from the late Donald G. Graham and other sources. Likewise he grafted the native dogwoods *(Cornus nuttallii)* blooming in late summer on the west side of Arboretum Drive, the hybrid pines along the nursery road and many more which could be listed.

From fall to spring over a period of 15 years, with two assistants, he planted hundreds of young trees and shrubs throughout the Arboretum, including the rhododendrons in Loderi Valley, the camellia garden, collections of *Cistus,* hollies, *Hypericum,* broom *(Cytisus),* Asiatic maples and *Sorbus,* to mention only a few of the larger groups. All these remain as long-term memorials to his skill and care, as do the records he systematically maintained for so many years of plants raised in the greenhouses, frames and lath houses.

Undoubtedly many members of Arboretum Units and of local garden clubs well remember his propagation classes, as well as the information he constantly and willingly supplied to enquirers by telephone and in person. Many also no doubt still possess plants raised at those classes and thus have souvenirs of a very capable and faithful worker in the Arboretum.

Unfortunately, due to a major operation and to increasing arthritis, he had to retire in December 1961, earlier than anticipated. He remained first at home in Issaquah, Washington, and later in Duvall where he died suddenly in July, aged 77 years. Mich can certainly be counted among those who have played a key part in the development of the Arboretum, and at a crucial period in its history.

BRIAN O. MULLIGAN

Carl S. English, Jr.

Our readers will be sorry to learn that Carl S. English, Jr. died on August 11. One of the outstanding horticulturists in the Pacific Northwest, he was largely responsible for developing the beautiful gardens at the Ballard Locks, where he worked for 43 years.

A full account of his life and contributions will appear in a forthcoming issue of the *Bulletin*.

Cornus Kousa **— a mature specimen in flower**

SOME OF OUR FAVORITES
Won't You Send Us Yours?

Cornus kousa

Choosing favorites from any well-loved group is always difficult — and no less so in the plant world. But at the moment of this writing, late June, *Cornus kousa* is making a strong bid for honors.

My tree was purchased at an Arboretum Foundation plant sale eight years ago and is now about eight feet tall. It could reach 20 feet as a mature tree. The upright habit of growth with arching branches makes the Korean dogwood one of the aristocrats of the family Cornaceae.

The two-to-four-inch deciduous leaves are opposite, somewhat convex and deeply veined. The flower-like inflorescences, which occur in profusion on a mature tree, are neatly arranged in rows on two-inch stems above the branches for almost their entire length. The four creamy white bracts which surround each dense flower head are similar to those of *Cornus nuttallii,* our Northwest native dogwood, although somewhat smaller, each "flower" two to three inches across.

With the graceful branches outlined in creamy white in June and July, this tree creates a dramatic effect on the edge of a woodland just after the riotous colors of the spring flowering rhododendrons and azaleas have faded. The blooming period extends from two to four weeks, depending on the weather, and before the "flowers" drop they often turn pink, appearing to have been brushed down the center of each "petal" by an artist's hand. This quality seems more pronounced in some specimens than in others.

Cornus kousa is a native of China and was introduced into cultivation in 1875. The University of Washington Arboretum has several fine specimens in Rhododendron Glen and around the stream by the cottage at the lower end of Arboretum Drive.

Cultivation is simple — it seems to thrive in the average garden situation although I suspect that like others of the genus it prefers some shade around its trunk. Since it likes to make two or more trunks, training must be started early if it is to be grown as a single-stemmed tree. However, it is attractive grown either way.

After the flower bracts have fallen, the reddish fruits remain on their two-inch pedestals as long as the birds will allow. In the fall, as though unwilling to give up the spotlight, the Korean dogwood presents a display of red and orange fall color rivaled by few other trees. The bare branching pattern in winter is handsome, never twiggy, and on close inspection the small round buds of next year's "flowers" may be seen enfolded by the tiny undeveloped bracts. As spring comes on and the leaves unfold, the bracts enlarge and turn from green to lighter green to their lovely creamy white.

Few small trees can give the gardener so much pleasure.

MRS. JOHN A. OGLE,
Secretary,
Arboretum Foundation, 1976-1977

From Acres to Inches

The Townhouse Garden of Mr. and Mrs. John M. Peterson

Twenty years ago we bought a home on Mercer Island to meet the needs of our young, active family. The lawn-covered acre and a quarter was good for swings, football and baseball, and it had the best sledding hill in the neighborhood. Plantings were minimal, but I found I enjoyed working in the garden while I watched the children.

When my children grew older and I had more free time, I began to work in the Unit Council greenhouse, and I became a "plant-oholic." Bit by bit the play areas were reduced as I expanded the garden beds to make room for more cuttings, seedlings, purchases and divisions from friends.

So it continued until, suddenly, it seemed our nest was empty and the maintenance of this large house and garden became a chore. After looking around for an entirely new situation, we bought a condominium townhouse. This is not an apartment but a modern version of the old rowhouse. Our unit has a private entry, and front and rear patios enclosed by six-foot fences. It isn't very big — from acres to inches!

"Oh, Sue, how can you leave your garden?" In a way I brought it with me. But I had the opportunity to start over, to leave my mistakes behind and to make more knowledgeable choices. My old garden just grew; this one would be carefully planned. The colors would coordinate with the interior of the house: reds, pinks and blues. Bloom would continue from early spring to late fall. Because I am still a hobby gardener, I had to have something of everything. Since the most important consideration was scale, I acquired a whole new area of interest — miniatures: small trees, smaller shrubs, smallest rhododendrons, tiny iris, ferns and prostrate groundcovers. Best of all I started with good soil; all the beds within our fences were excavated to the depth of at least 18 inches and filled with three-way mix.

It would be perfect — no mistakes — I had planned it! But I hadn't taken sentiment into consideration. When I had to decide which plants to bring from the old garden, something happened to my ideal plan. How could I leave the *Rhododendron* 'Bo-Peep' a good friend had given in memory of my father? In spite of its color, yellow, it came along. The same thing happened with primrose 'Dorothy,' the gift of another friend a few years before her death. Those seedling rhododendrons that had not yet bloomed came too.

Philosophically, I have concluded that a real garden is always developing and changing. My garden of inches will never be perfect or complete.

Against the garage in the entrance patio (Bed I, 7′3″ by 2′3″) I have espaliered *Camellia* 'Donation' (1), whose beautiful pink flowers arrive early and last a long time. *Rhododendron ciliatum* (2) flanks it in a protected spot where its March bloom will escape frost damage, accompanied by *R. williamsianum* (3), *R. vilmorinianum* seedlings that I started and *R. lepidotum* var. 'Ruethe's Purple' (4). Begonias give summer color and help to hide the dying foliage of bulbs.

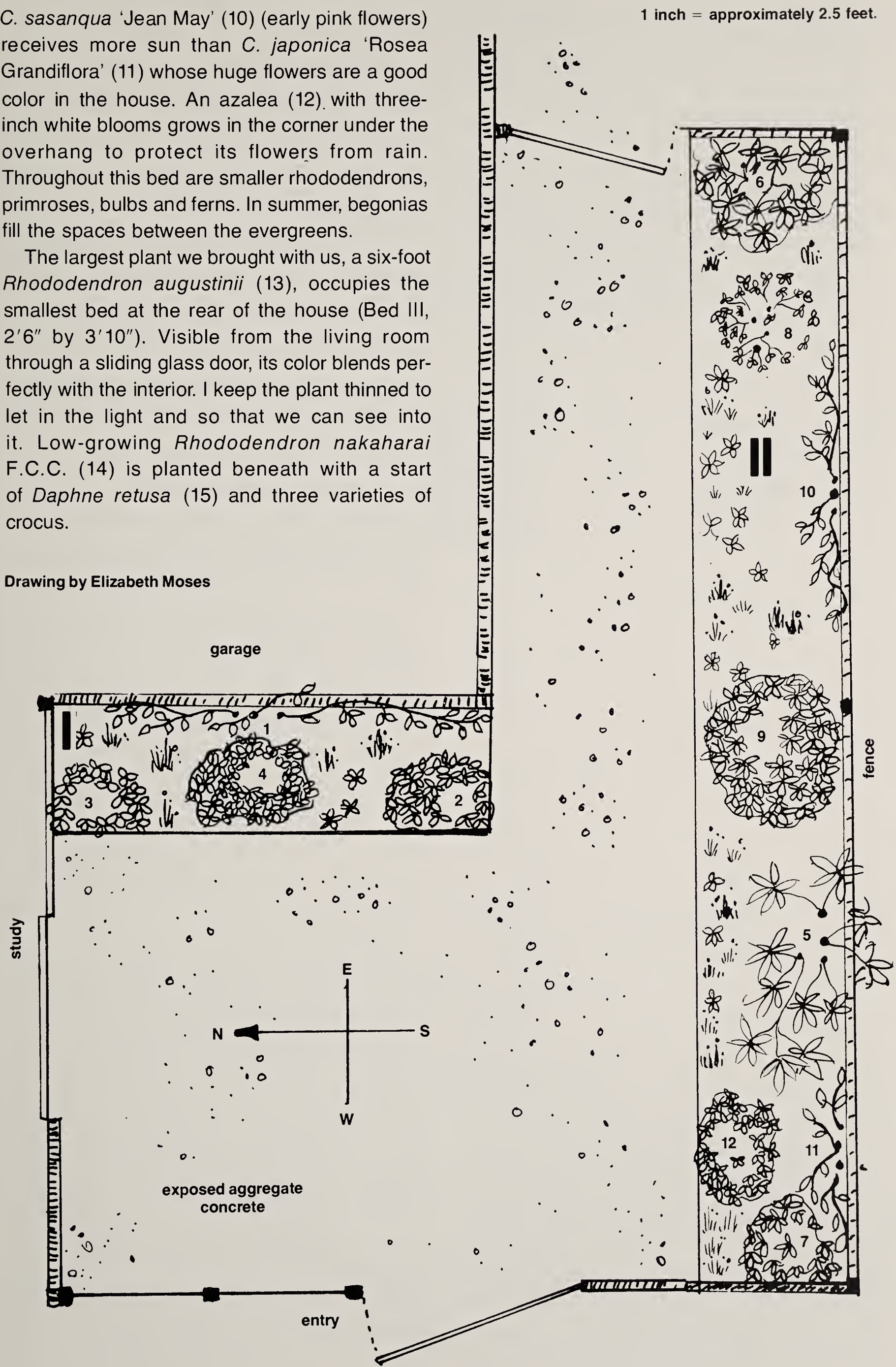
Rhododendron 'Loderi King George' (5) dominates the bed along the fence from the outside gate to the front door (Bed II, 18′ by 2′3″). The fragrance of its huge white flowers perfumes the entire court and house in May. In this narrow space it must be trained as a tree. Excellent in bloom or berry, or for its foliage alone, *Skimmia japonica* (6) furnishes cutting material for the house the year round. A dwarf male *Skimmia* (7) ensures a supply of berries. *Enkianthus perulatus* (8) stands against the fence; this four-star shrub has a lovely bare branching pattern in winter, white drooping bells in spring, beautiful summer foliage and a smashing red flash of fall color.

Rhododendron yakusimanum (9) does not bloom in this location, probably from lack of sun, but the texture, the compact form and the color of its foliage have earned it a permanent home. Two camellias are espaliered against the fence;

C. sasanqua 'Jean May' (10) (early pink flowers) receives more sun than *C. japonica* 'Rosea Grandiflora' (11) whose huge flowers are a good color in the house. An azalea (12) with three-inch white blooms grows in the corner under the overhang to protect its flowers from rain. Throughout this bed are smaller rhododendrons, primroses, bulbs and ferns. In summer, begonias fill the spaces between the evergreens.

The largest plant we brought with us, a six-foot *Rhododendron augustinii* (13), occupies the smallest bed at the rear of the house (Bed III, 2′6″ by 3′10″). Visible from the living room through a sliding glass door, its color blends perfectly with the interior. I keep the plant thinned to let in the light and so that we can see into it. Low-growing *Rhododendron nakaharai* F.C.C. (14) is planted beneath with a start of *Daphne retusa* (15) and three varieties of crocus.

Drawing by Elizabeth Moses



The short bed in front of the used-brick chimney (Bed IV) will someday be dominated by *Eucryphia* 'Nymansay' (16), which I plan to prune as a small open tree. It should like the full sun, protected position and the retained heat from the chimney. Eventually it will produce flowers in midsummer when the patio receives the most use. *Rhododendron reticulatum* (17) and *Azalea* 'Rosebud' (18) are taking this much sun comfortably. At the base of the *Eucryphia, Rhododendron trichostomum* var. *ledoides* (19), one of my favorites, has a full, perfect, one-inch truss of delicate pink flowers. *Enkianthus campanulatus* var. *albiflorus* (20) can grow as tall as it likes in a small niche beside the chimney. Framed by a narrow window it is lovely to look through.

The south property line has a garden running the length of it (Bed V, 22′ by 2′) with a fence that provides shade for more rhododendrons, camellias and begonias. I plan to let two espaliered camellias cover the fence; they are my own cuttings, *C. japonica* 'First Flush' (21) and *C. sasanqua* 'Apple Blossom' (22). *Cornus kousa* var. *chinensis* (23) grows between them, a small light-scaled summer blooming tree that is a must for my garden. At the far end of the bed *Photinia villosa* (24), another small tree, gives lovely bloom in spring followed by bright red berries. A number of small rhododendrons earn their space with special qualities of bloom, habit or foliage.

A fence runs along the 24-foot width of the property with double gates at the south end leading out to the grounds of the condominium complex. Since we enjoy the view, we leave them open. This gently sloping sunny stretch (Bed VI) with its rock scree offers a perfect place for plants that like sun and drainage. The most spectacular plant in the garden, a three-by-three-foot *Rhododendron yakusimanum* (25) blooms its head off in this location. Three species of *Lewisia* (26), crocus, *Iris danfordiae* and cyclamen grow here with *Rhododendron oblongifolium* (27) (sweet scent, July bloom) and dwarf *Pyracantha* 'Tom Thumb' (28). Tumbling over the ground is *Acaena microphylla* (29) whose long-lasting red seedheads shine in the sunlight. *Euphorbia veneta* var. *wulfenii* (30) begins to bloom in March and keeps an attractive appearance well into July. Of the two *Rhododendron radicans,* the more compact one (31) is of blooming size, though only three inches across and one inch high, while the larger (32) is about five inches high with a 10-inch spread and is at least 15 years old.

Rhododendron trichanthum (R. villosum) (33) marks the beginning of the shady area in this bed. Against the fence is a seven-foot *Podocarpus* (34). It was originally a 39-cent grocery store plant acquired after I had admired specimens of it in California. Since the plant is supposed to be tender here I kept it in a tub so that it could be moved indoors during a freeze. When I was unexpectedly gone for several weeks one Christmas, the tub remained outside throughout one of our more severe freezes. Thus convinced that it was sufficiently hardy, I planted it in the ground. The texture of this conifer resembles that of a pine with very thick needles. Probably it will not outgrow this spot for many years.

The principal tree in this bed is *Rehderodendron macrocarpum* (35) which has grown from a six-inch door prize at a Unit Council meeting. This small, rare tree, a member of the Styrax family, has drooping flowers and interesting fruits.

Rhododendron 'Bo-Peep' (36), about six feet tall and three feet across (a dwarf?) occupies the corner of this bed. It has picturesque peeling bark and I am encouraging its open habit so that small things can grow underneath. Throughout the bed are other rhododendrons including *R. metternichii* (37), *R. hanceanum nanum* (38) with its bronzy new foliage and *R. nakaharai* 'Mariko' (39) which blooms in July and August. A small gravel path bordering this bed leads to a hose bib on the house. Nearby *Camellia sasanqua* 'Showa-no-Sakae' (40) will help to mask the fence and the hose.

In the sunny, well-drained location against the house (Bed VII) I have placed some rocks among a variety of plant material. Next to *Chamaecyparis obtusa nana* (41) in the corner are *Quercus sadleriana* (42) near the wall with *Tripetaleia bracteata* (43) for brilliant fall color in front. *Ilex crenata* var. mareisii (44) should be able to grow there forever with its columnar habit; the tiny round leaves have a lovely pattern. *Rhododendron chasmanthum* (45) and *R. wardii* (46) take a lot of sun. *Lithospermum* 'Heavenly Blue' (47) covers the ground among the rocks and *Geranium sanguineum lancastriense* blooms profusely with exquisite pink flowers. *Rhododendron ravum* (48), a seedling from another friend, blooms heavily and remains neat.

R. quinquefolium (49) with its silver-edged foliage and white bells is conspicuous. *Pieris japonica nana* (50) has all the good qualities of the type and stays small. A dwarf *Hebe* (51) thrives next to a rock. *Helichrysum bellidioides* (52), with its tiny everlasting white daisies, and three kinds of dwarf iris are along the path. Tiny *Campanula cochlearifolia (C. pusilla)* holds its single, large blue bells about two inches off the ground and two dwarf veronicas hold their spikes a little higher. A clump of dwarf London Pride *(Saxifraga* sp.) adds pink color. Another *Photinia villosa* (53) will spread out over this bed in the future.

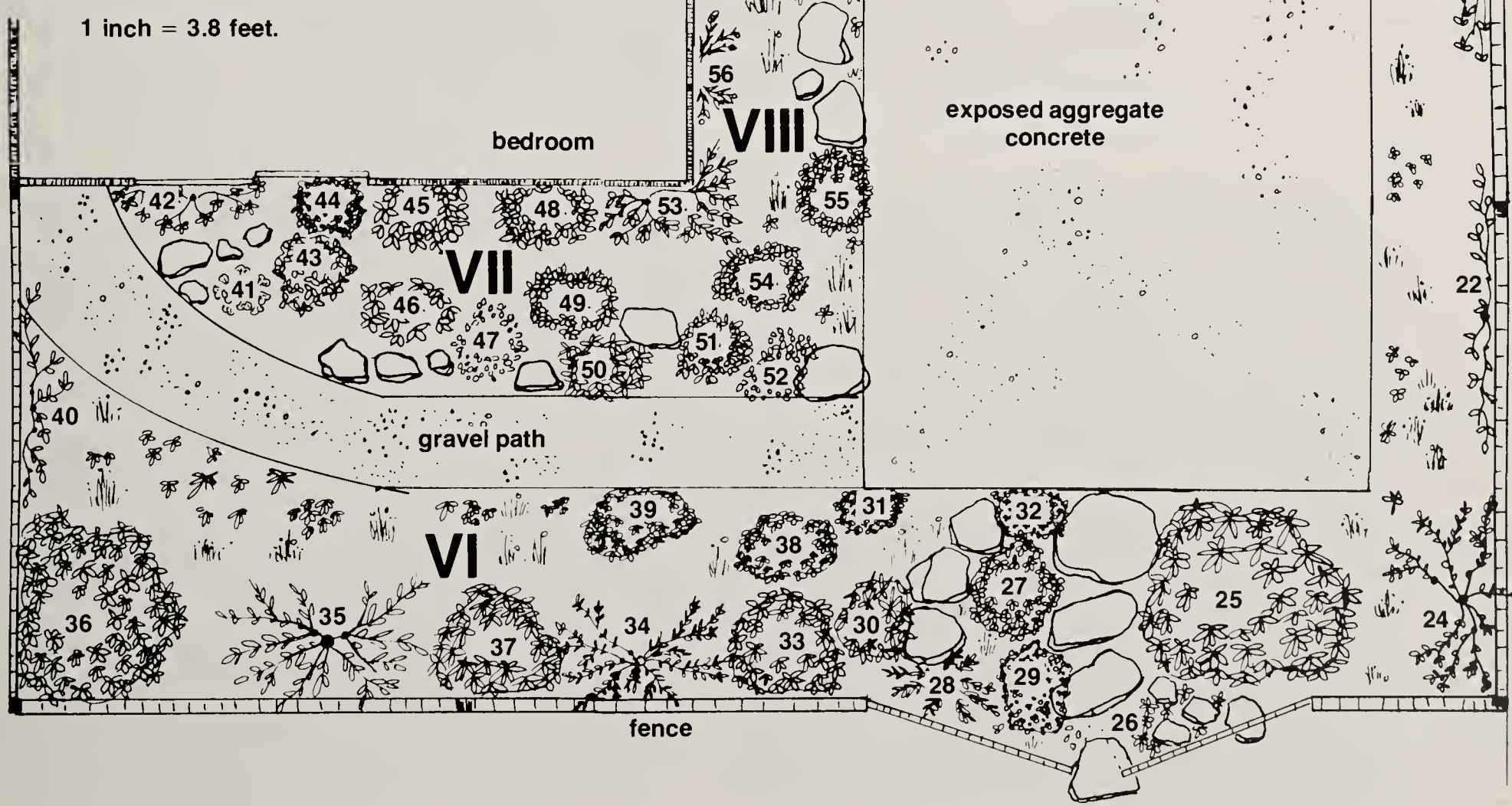
At the corner (Bed VIII), the sunniest spot in the garden, is a mature specimen of *Rhododendron impeditum* (54). *R. forrestii* var. *repens* (55), absolutely prostrate on a rock, flourishes next to the hot patio concrete. A hardy species of *Dimorphotheca* (56) sprawls around the corner of the house, producing lavender daisies from early spring until frost. The rest of the bed is planted with small bulbs for spring bloom, followed by annuals for summer color

And this is my garden for the present. I have 40 different rhododendrons, 6 different camellias, about 10 various azaleas, 6 types of trees and so much more! How am I going to keep them all? I do not intend to try, but rather to change the garden constantly. When plants outgrow their space I will give them to the Arboretum Plant Sale and buy more new treasures, hopefully miniatures that will fit into that perfect plan for which I was striving.

SUZANNE PETERSON

*Mrs. John M. Peterson has served the Arboretum Foundation in a number of capacities including Horticultural Chairman of the Unit Council, Plant Sale Chairman and as a Director of the Foundation. She was a major inspiration in launching the Arboretum Explorers, which serves the public so successfully by offering guided access to the Arboretum monthly.

Drawing by Elizabeth Moses



Announcements from the Unit Council

Unit Council meetings for 1976-77 are scheduled from 9:30-12:00 a.m. at St. Stephen's Episcopal Church in Laurelhurst on September 16th, November 18th, March 17th and May 19th. In addition to a short program, the agenda includes news of various Unit Council activities, a report of progress at the Arboretum and an exhibit of interesting horticultural specimens. Any member of an Arboretum Unit is welcome.

This year regional meetings are being planned for all unit members in each district. Look for announcements of these events.

Two sessions of the botany course given by Dr. Janet Hohn, which was so successful last year, will be offered by the Foundation this fall — one morning and one evening section, each meeting for 10 weeks. To enroll, call Sally Sue Coleman at 822-3300 or the Foundation office at 325-4510.

It is suggested that members who would like to have early enrollment information for future Unit Council classes place their names on the Education Committee's mailing list by calling the above numbers.

A training program for Arboretum guides (in areas other than the Native Trail and the Japanese Garden) will begin this fall. To acquaint trainees with areas in the Arboretum that are colorful in the fall, Joe Witt will lead walks on the following Saturdays: October 2nd, 16th and 30th from 10 to 12 a.m., meeting at the office. In the early spring he will also show areas to be visited for spring color. If you would like to share your enthusiasm for Northwest gardening and want to know your Arboretum better, sign up for this program. Guides will be expected to lead at least two tours annually. Please call Elizabeth Moses at 822-9346 or the Foundation office at 325-4510 for questions or to register.

The House Plant Study Group has now become Arboretum Unit 84 with Marilyn Watts as its chairman.

Unit Council Governing Board 1976-1977

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Notes and Comments

A catalogue of plants in the Arboretum is now complete in typescript and has been carefully edited by Miss Emily Johnson, retired Director of Scholarly Journals for the University of Washington.

Sample printed pages are being obtained from several sources by Mr. John Murphy, editor for the College of Forest Resources, in order to decide the best format and types for printing this work. It is expected to be a small book, six by nine inches in size, containing some 250 pages.

A joint committee of the University's College of Forest Resources and the Arboretum Foundation has been set up to oversee production.

The fourth Arboretum-sponsored tour of the Orient is departing October 18, 1976. If the *Bulletin* arrives in time, space is still available for those who would like to jump on at the last minute. Brochures may be obtained at the Foundation office or call Marguerite Sherman 232-7535.

We are very pleased to welcome two new members to the Editorial Board. Dr. Linda B. Brubaker is Assistant Professor of Dendrochronology on the faculty of the College of Forest Resources, University of Washington. An overview of her field of specialization appears on page 2. Mrs. Donald W. Close (Ruth Mary) is a long-time active member of the Arboretum Foundation. She will have special responsibility for articles pertaining to the Unit Council.

Nancy Walz has joined our staff as editorial assistant replacing Lisa Shawver. She is a graduate of the University of New Hampshire having majored in English.

In the Arboretum Foundation office, Lois Stearns has succeeded Candace Lawson as assistant secretary.

New Members of the Arboretum Foundation

We are pleased to welcome the following new members (May 7, 1976 through July 16, 1976):

Contributing John J. Albers, Mr. and Mrs. George W. Mally. *Sustaining* — Mr. and Mrs. Henry G. Dougan, Mrs. Nathan Gross, Mrs. Ruth M. Kildall, Mrs. John R. Norton, Mrs. F. R. Steele, Emil Zivner. *Annual* — Mrs. Jack L. Agan, Mrs. Jane Abbott, Mrs. E. S. Amyes, Mrs. R. H. Branchflower, Mrs. Agnes A. Brauer, Mr. and Mrs. Ralph Bremer, Mrs. Charles R. Burdell, Mrs. Richard S. Carlson, Mrs. Hugh Clark, James Coyne, Mrs. D. F. Davison, Mrs. H. P. Dopheide, W. Thomas Drummond, Mrs. James Edwards, Mrs. Gayle Engle, Joseph E. Evans, Mrs. Winifried K. Feifel, Mrs. Albert L. Fisher III, Wendy Fremmerlid, Mrs. Joy Garrison, Mrs. Bruce Gascoigne, Mrs. Robert Gooch, Mrs. Patricia Gordon, Marion Gramann, Mrs. Larry R. Granston, James L. Green, Mrs. C. R. Greenfield, Mrs. Robert Hall, Mrs. Carol Hansen, Mrs. Charles J. Henry, Mrs. Marguerite M. Kemble, Clifford Kemp, Mrs. Charles F. Keyes, Mrs. Warren Lee, Mrs. Chris LeFevre-Smith, Joyce Lindsay, C. R. Lonegran, Jr., Miss Marilyn Loudon, Mrs. Norman F. Lough, Miss Catherine L. Matson, Mrs. Guy Martin, Mrs. Charles Moeller, Mrs. Dan Moilanen, Mrs. Anne Williamson Napier, Mrs. George B. Olson, Mrs. Elva Jo Paget, Ms. Carol H. Pease, Mrs. Joseph L. Phillips, Ms. Toni Reineke, Mrs. Janet A. Scott, Mrs. Fritz Schreder, Mrs. William T. Shaub, Lois Shea, Mrs. F. Fred Simpson, Mrs. Parker R. Smith, Jr., Mrs. William Sprague, Nancy Storey, Mrs. James E. Stroh, Jr., Mrs. William Talbott, Mrs. Margaret Van Dyke, Mrs. Kenton G. Van Nortwick, Mrs. R. Willstadter, Frank Wrespir, Miss Dorsey Wyble.

We are also grateful to the following who have increased their dues to: *Contributing* — Mr. and Mrs. James Fukuda. *Sustaining* — Mrs. Ruth Audette, Dave Brastow, Mrs. H. Richard Bushley, Mrs. T. G. Dalby, Mrs. Joan C. Kestle, Mrs. J. W. Reynolds, Mrs. Bernard Sevener, Mrs. John P. Stewart.

University of Washington Classes

Arboretum classes and many other programs of interest are listed in *Spectrum,* the continuing education publication of the University of Washington. Since it is not always possible to coordinate publication of the *Arboretum Bulletin* with registration dates, those who wish to obtain early notice of such classes are urged to place their names on the mailing list for *Spectrum,* free of charge, by calling 543-2590.

ARBORETUM CLASSES

IDENTIFICATION OF NATIVE TREES AND SHRUBS. Dr. James Long, forest ecologist, will teach this field class on identification. Over 40 species of common trees, shrubs and ferns native to western Washington will be covered. Each section limited to 15; meet at Arboretum office. Saturdays, Sept. 25, Oct. 2, 9, 16; 4 sessions, $10. Section A: 10 a.m.-12 noon. Section B: 12 noon-2 p.m.

FALL TOURS. Mr. Joseph Witt, plant curator, will conduct tours of the Arboretum in fall color, including the Oak Section and Woodland Garden. Class limited to 25. Saturdays, Oct. 2, 16, 30; 10 a.m.-12 noon. Meet at Arboretum office. 3 sessions, $5.

HOUSE PLANTS. Mr. Richard van Klaveren, Arboretum propagator, will discuss indoor plants. Topics covered include houseplant identification, techniques of propagation and care. Materials furnished. Arboretum greenhouse; class limited to 15. Saturdays, Oct. 2, 16, 30; 9:30-12 noon. 3 sessions, $15.

PRUNING ORNAMENTALS. Mr. Chico Narro, expert nurseryman, will demonstrate techniques of pruning trees and shrubs. This is an outdoor demonstration class; appropriate clothing and waterproof footwear are recommended. Class limited to 30; meet at Arboretum greenhouse. Saturdays, Nov. 6 and 20; 10 a.m.-12 noon. 2 sessions, $5.

To register, send check made payable to the University of Washington to: Arboretum Courses, Anderson Hall (AR-10), University of Washington, Seattle, WA 98195.

For further information call 543-2730.

CONTINUING EDUCATION

THE MOUNTAIN ENVIRONMENT. Mountains have long been the object of man's scientific and adventurous curiosity. In a major nine-session noncredit lecture-discussion series, specialists in mountain studies will explore aspects of the mountain environment. Special attention will be given to mountains of the Northwest. Topics will include mountain history as evidenced in rocks, glaciers and land forms, and their effects on climate, plants, animals, economics, art and the societies that inhabit mountain regions. The series begins October 7 and will feature a different guest speaker each week. Course coordinator is Fiorenzo Ugolini, Professor of Forest Resources.

IDENTIFYING MUSHROOMS OF THE PACIFIC NORTHWEST. This course is designed to acquaint persons with common mushrooms of the area, including information on where and when to look for mushrooms, poisonous and edible properties and methods of preservation. Daniel Stuntz, Professor of Botany. Mondays, beginning Sept. 27. 10 weeks, $40.

PHOTOGRAPHY courses, one in black and white, the other in color. The latter includes information on how to photograph special kinds of subjects, making up slide shows, etc. James Sneddon, Manager, Broadcast and Photo Services, U. W. Information Service. Begins Oct. 4.

Registration information for the above offerings is in *Spectrum,* available by calling 543-2590, or call Continuing Education, 543-8037.

Edmonds Community College

The Horticulture Department of the Edmonds Community College offers a wide selection of plant, garden and nursery-related classes in day or evening sessions. Subjects covered in Fall 1976, include: Native Plants (3 credits), House Plants (4 credits), Weed Identification (4 credits), Autumn Plant Identification (6 credits), Landscape Studies (1 credit), Landscape Maintenance Practices (3 credits), Fundamentals of Horticulture Biology (4 credits), Horticultural Chemistry (2 credits), Sprinkler Design and Repair (5 credits) and Retail Nursery Design (3 credits).

Registration is by appointment only during late September. Classes begin September 28. Cost is $8.50/credit hour, plus a first time registration fee of $5.

For further information contact: Walt Bubelis 775-4444, ext. 257 or Dennis Thompson 775-4444, ext. 335.

Book Reviews

PLANTS AND ANIMALS OF THE PACIFIC NORTHWEST, by Eugene N. Kozloff. University of Washington Press, Seattle and London, 1976. 264 pp. Price $17.50 ($14.95 before Dec. 31).

Apart from his contributions as Professor of Zoology at the University of Washington, Dr. Kozloff has already made a name for himself with his 1973 book *Seashore Life of Puget Sound, the Strait of Georgia, and the San Juan Archipelago* (see our review in the *Arboretum Bulletin,* Winter 1974) and his *Keys to the Marine Invertebrates of Puget Sound, the San Juan Archipelago, and Adjacent Regions*. In this new guidebook, which can be used with pleasure and profit by specialist and non-specialist alike, he not only lives up to his excellent reputation — he has surpassed himself!

With the aid of 125 instructive black-and-white figures and 321 excellent color photographs (all but four taken by the author himself), he has produced a general natural history, covering about 450 plants and animals of western Washington, Oregon and British Columbia in the form of a single volume which can easily be taken along on field trips. (The only reservation might be that many owners will feel so protective about their treasure that they may wish to provide it with the best waterproof jacket available.) The need to carry around and to consult a number of different books, for example one on trees, another on wild flowers, a third on frogs, toads and salamanders, etc., has suddenly become much less urgent!

Of course the author had to make choices, but he has made them wisely. It is quite understandable that he did not include many insect species. There may be well over a million of those on our planet, and doing a superficial job is not in Dr. Kozloff's mental makeup; the interested reader is indeed well-advised to consult special books for Pacific Northwest insects.

For trees, shrubs, vines, major wildflowers, ferns and fern allies, as well as for amphibians and reptiles, however, the book is remarkably complete. In addition, Dr. Kozloff brings in a wide selection of mosses, liverworts, lichens, snails, slugs, millipedes, centipedes and certain other invertebrates. A few important or conspicuous mammals are also presented, and helpful hints are given to those interested in beginning bird studies.

The book is psychologically good because it eliminates so successfully the fear of being-overwhelmed-by-the-richness-of-it-all which beginning amateurs might harbor. It certainly is very helpful that in his introduction the author gives brief but adequate descriptions of the various sub-regions of our Pacific Northwest such as Willamette Valley, Puget Trough and Olympic Mountains. He gives ecology a fair share, in addition, by organizing the subject-matter around certain habitats and biotic assemblages that are common in our region and therefore immediately "ring a bell" in

the reader. Thus, he presents a coniferous forest (Chapter 2); oak woods, rocky slopes and brushy areas (Chapter 3); wet places (Chapter 4); and backyards, vacant lots and roadsides (Chapter 5). Vertebrate animals get their own chapter (Chapter 6). The value of the book is increased by the very useful glossary, references and index.

The author's thorough knowledge of our living creatures based on long experience shines throughout the text, as well as his enthusiasm, which he somehow manages to combine beautifully with modesty, restraint, caution and a good critical attitude. We have been awaiting just such a book for a long time. It definitely fulfills a need, and we would love to see it in thousands of hands. Both the author and the publisher should be congratulated on a job splendidly done.

BASTIAAN J. D. MEEUSE

TREES FOR THE ROCKY MOUNTAINS, by George W. Kelly. Rocky Mountain Horticultural Publishing Co., Cortez, Colorado, 1976. 120 pages. Price $3.50

Those of us who garden in the relatively soft and mild climate of western Washington sometimes shudder when we hear of the trials of those who must try to establish a garden in areas not too far east of us. The Rocky Mountain area (including the eastern edge of Washington and Oregon, all of Idaho, Nevada, Montana, Wyoming, Utah, Colorado, the western portions of the Dakotas, Nebraska, Kansas and the northern half of Arizona and New Mexico) is a region of, as the author of this paperback-book states "arid-alkaline conditions." Add to this the generally high elevation with its attending short growing season, and anyone gardening there is going to need all the help available.

Mr. Kelly's book will be welcome since it represents a combination of his expertise with trees of the area and a series of lists of trees growing in various areas throughout the region compiled by local authorities.

The first portion is devoted to a list of trees for the Rocky Mountain area. Each species included has a short paragraph with descriptive material, a zone designation indicating where it will grow best and often a word of warning or commendation about the particular tree. This section is followed by lists of trees of various types and for various sites, a short but well-planned chapter on tree care, the tree lists for various regions and finally the zone map and the explanation of the various zones. This latter is interesting in that the author feels the zone maps developed by the Arnold Arboretum and improved by the U. S. Department of Agriculture have little relevancy for his area. There is much truth in this; however, one is forced to question the accuracy of Mr. Kelly's zones. Spokane is placed in his zone 3 "Urban 4,000-6,000 feet elevation, at the foot of the mountains with level soil, some alkalinity and hot sun." It is surrounded by zone 1 "Desert 4,000-6,000 feet, very little rain, very hot sun, often very alkaline soil." Readers who know northeastern Washington would feel this to be a not very accurate description of the wooded hills and agricultural valleys of that area. The wheat farmers of the rich Palouse might be surprised to find they live in zone 5 "Mountain 6,000-8,000 feet, natural rain, shorter season, less alkaline soil."

Aside from these complaints and the fact that there are a few errors in plant names such as describing *Platanus acerifolia* (London plane) as "an European species" when it is actually a hybrid between the American and Oriental plane trees, or in still calling Douglas fir *Pseudotsuga taxifolia* instead of *P. menziesii,* the book should be of great use to those interested in planting trees east of the Cascades.

JOSEPH A. WITT

BUTTERFLIES AFIELD IN THE PACIFIC NORTHWEST, by William A. Neill, M.D. Photography by Douglas J. Hepburn. Pacific Search Books, Seattle, August 1976. Illustrated with 74 color photographs. 96 pages. Price $4.95

This book complements very felicitously R. M. Pyle's recent book on the butterflies of Washington State, reviewed in the *Arboretum Bulletin* (Fall, 1974). Distinguished by its good style, the text is deliberately kept very short. The first five paragraphs give a general introduction covering, respectively, "Seasons" (when one can expect to find the adults), "Scaly Wings" (a brief characterization of the class of butterflies and moths), "Metamorphosis," "Habitat" (seven different regions of the Pacific Northwest, with the particular butterfly species that characterize each), and "Species" (which gives at least some taxonomic, nomenclatural and genetic background).

This is followed by the "Guide for Identification — by color and other physical characteristics." In this section the nearly 200 kinds of butterflies residing in the Pacific Northwest have been divided into 10 groups on the basis of simple and logical criteria; for example, anglewings are lumped together because of their ragged wing margins and the dead-leaf pattern displayed on the underside of their wings, while certain other butterflies are put in the group of the "sulphurs, whites and parnassians" because they all are bright yellow or white with black markings. In this section the text is very brief and straightforward. It is obvious that the authors are relying heavily on the color photographs, and indeed these are of high quality.

There is very little in this book one can take issue with. It was, of course, amusing to read that butterflies are indeed animals. One can also point out that some butterflies have only four functional legs and not six. However, this is hairsplitting. The book will give enjoyment and sound information to many, and we recommend it highly.

BASTIAAN J. D. MEEUSE

INSECTS THAT FEED ON TREES AND SHRUBS, AN ILLUSTRATED GUIDE, by Warren T. Johnson and Howard H. Lyon, with the collaboration of C. S. Koehler, N. E. Johnson, and J. A. Weidhass. Cornell University Press, 1976. Price $35.

Entomologists seem to have an obsession with names. Viewing an exquisite scene of flitting butterflies, they seem to take a sadistic pleasure in crush-

ing each butterfly with a heavy frag[illegible] lian nomenclature. Sometimes ent[illegible] go to extraordinary lengths to att[illegible] number of names to a passing insect: "That is *Malacosoma disstria,* a lepidopteran of the family Lasiocampidae, the forest tent caterpillar." Like so many obsessions, this preoccupation with names originates in a deep sense of insecurity. No entomologist feels confident in his knowledge of the teeming insect world, and whenever he chances to spy an insect that he does recognize he is compelled to announce its name in a gesture of defiance to the great unknown majority.

Occasionally a major identification manual is published, an important new weapon with which to subdue whole regiments of the incogniti. These manuals are usually taxonomic monographs, of little use to members of the general public who are unwilling to look for parapsidal sutures, metepimera, and other, possibly imaginary, characters routinely used in taxonomic keys. In its scope and authoritative treatment, *Insects that Feed on Trees and Shrubs* is one of the most impressive recent manuals for identification of a group of North American insects and to make matters better it is arranged not as a taxonomic guide but as a field guide. This is the first insect field guide covering a large group of insects that is as easily used by the gardener or unspecialized naturalist as by the professional entomologist.

The quality, quantity and presentation of the illustrations are chiefly responsible for making this book such a successful guide. There are well over 1,000 color photographs of insects and the symptoms they cause on their host plants. Each insect is usually illustrated in a series of photographs that customarily begins with a view of distinctive host symptoms that might first attract one's attention to an infested tree; then one stalks the pest in a series of two or more progressively closer views, concluding with a photograph of the insect as it would appear through a moderately strong hand lens. In many cases several stages of the life cycle are portrayed. Such creatures as gall insects and stem borers that are normally hidden by plant tissue are usually shown exposed in carefully dissected material. Accompanying each page of illustrations is a page of text with brief accounts of the biology of the insects portrayed. This account usually includes the geographic range, life cycle and preferred host material.

The following example shows the guide in action. In the Seattle area most boxwood hedges show a characteristic curling or cupping of the new leaves. Early in the summer these cupped leaves contain small green insects with whitish, waxy tufts. The host plant index [illegible]ntains a whole list of insects includ- [illegible] leaf feeders and sucking insects. [illegible]damage suggests a sucking insect, a quick survey of the photographs of those which attack boxwood reveals that the insect is the boxwood psyllid. On the other hand, if the identity of the pest is suspected, one can either look in the insect index under "psyllid," or in the plant host index under "Boxwood, sucking insects, psyllids."

Recommendations for pest control are not included. This omission is disappointing but inevitable since control procedures change from year to year, and the best pest control in a particular case is determined by economic considerations, health hazards involved and the actual virulence or persistence of the pest population. By avoiding discussions of pest control the authors avoid obsolescence and perhaps even malpractice charges. The book contains, however, a list of agricultural colleges and experiment stations where control recommendations may be obtained. Much additional information can be found in the 322 publications cited in the text.

Insects that Feed on Trees and Shrubs has been rather extensively field-tested in the Seattle area during the last few months and has proved to be quite satisfactory. Geographically restricted, sporadically abundant or recently naturalized species are sometimes omitted to reduce the book to a manageable size and price. A few common species, such as the pine butterfly and the hawthorn psyllid, are not discussed at all; a few species, such as the boxwood leaf miner and the bean aphid (a serious pest of golden chain tree) do not appear in the host plant index and can only be located in the text if their identities are already known.

There is one rather annoying feature of the book's format. The authors have clearly followed a very strict standard of brevity, denying themselves and us the presentation of much of the biological information known about many of the insects that are discussed. Some of this information might have been included since the pages of text are only partially filled, leaving the book about a quarter blank.

As a comprehensive guide, *Insects that Feed on Trees and Shrubs* has set a new standard. It is suddenly apparent that we must have companion volumes dealing with field-crop insects, home garden and lawn insects and insects of medical and veterinary importance. All that is needed to obtain each of these additional volumes is another prodigious effort by a closely cooperating team of renowned entomologists working steadily for about 10 years.

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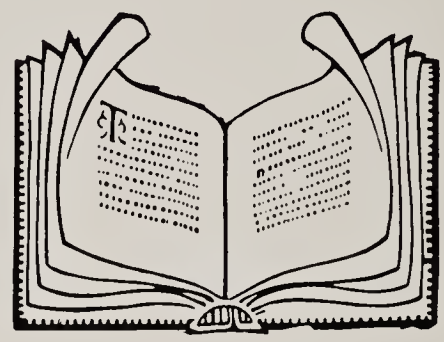

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THE ARBORETUM FOUNDATION

STATEMENT OF CASH RECEIPTS, DISBURSEMENTS
AND CHANGES IN CASH BALANCES

YEAR ENDED APRIL 30, 1976*

	Current Funds			Endowment Trust Fund (Note 3)		Total all funds
	Unrestricted	Restricted	Building Fund	Principal	Interest	
Receipts:						
Dues	$ 20,975					$ 20,975
Donations	4,701					4,701
Unit Council-						
Plant and bulb sale	39,953					39,953
Other	2,835					2,835
Interest on savings and investments	26,612		$ 8,762			35,374
Income from investment trust					$ 995	995
Advertising and miscellaneous	3,599					3,599
	98,675		8,762		995	108,432
Disbursements:						
Salaries and wages	16,250					16,250
Payroll taxes	1,464					1,464
Membership expense	459					459
Bulletin and publication	13,200					13,200
Publicity and educational program	2,671					2,671
Telephone	423					423
Other operating expenses	10,071				400	10,471
Unit Council expenses-						
Plant and bulb sale costs and expense	20,377					20,377
Utilities, supplies and postage	6,377					6,377
Frost damage study	5,068					5,068
Donations to University of Washington Arboretum	16,435					16,435
Donations to Japanese Garden	18,000					18,000
Donation to Memorial Gates	2,108					2,108
	112,903				400	113,303
Excess of disbursements over receipts	(14,228)		8,762		595	(4,871)
Allocated cash balance at April 30, 1975	478,056	$3,938	127,861	$244	455	610,554
Allocated cash balance at April 30, 1976 (Note 1)	$463,828	$3,938	$136,623	$244	$1,050	$605,683

*Financial Statement as prepared by Price Waterhouse & Co is available in Arboretum Foundation office

THE ARBORETUM BULLETIN

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Seattle, Washington 98195

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CALENDAR OF EVENTS

DATE	EVENT
September	
9	Unit Council Governing Board
9	Foundation Board of Directors
16	Unit Council Meeting
October	
7	Unit Council Governing Board
14	Foundation Executive Committee
November	
4	Unit Council Governing Board
11	Foundation Executive Committee
18	Unit Council Meeting
December	
2	Foundation Board of Directors

DATES TO REMEMBER

Thursday, April 14 — Work and Fun Day

Wednesday, Thursday, May 4 & 5 — Plant Sale

REGULARLY SCHEDULED:

Every Tuesday	Greenhouse Day
1st Monday	Rhododendron Study Group
1st Friday	Herbarium Committee
3rd Monday	Northwest Natives Study Group
3rd Wednesday	Rock Garden Study Group
4th Wednesday (except Dec.)	Arboretum Explorers

FOR INFORMATION, CALL 325-4510